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TOP SECRET

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NATIONAL PHOTOGRAPHIC
INTERPRETATION CENTER

USER'S MANUAL FOR THE REAL-TIME MENSURATION PROGRAM

Second Edition

25X1

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MAY 1973
COPY NO. 68
PAGES 462

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25X1

MEMORANDUM FOR: Recipients of [redacted] 25X1
User's Manual for the Real-Time
Mensuration Program, Second Edition
Dated May 1973

SUBJECT : Transposition of Photographs

The photographs on pages II-26 and II-27 were inadvertently transposed in this manual. New pages II-25, II-26, II-27, and II-28 are attached. Please insert these new pages and destroy the pages in error.

WARNING NOTICE
Sensitive Intelligence Sources and Methods Involved.

CLASSIFIED BY: 013170
Exempt from General Declassification Schedule of E.O. 11652, Exemption Category: 5B(2)
AUTOMATICALLY DECLASSIFIED ON DATE IMPOSSIBLE TO DETERMINE

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Placing
The Chips

Placing the chip(s) on a [redacted] comparator involves these steps in the order listed. 25X1

1. Place the chip(s) on the stage of the viewing unit.

2. Using the film clips, clamp the film down.

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HIGH-PRECISION-STEREO
COMPARATOR

The High-Precision-Stereo Comparator (HPSC) appears in Figure 5. This device permits stereo viewing of frame, panoramic, and strip stereoscopic photography. For information on the operation and maintenance of this device see the following manuals which are kept in the HPSC remote station -- 25X1

* Stereocomparator Operator's Manual, [redacted] 25X1

25X1

* [redacted] Systems and Stereo Comparator Program Documentation, Section 4, "Operations," [redacted] 25X1

25X1 * Computer Program Specifications and Instructions, [redacted]

FIGURE 5. HIGH-PRECISION-STEREO COMPARATOR.

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25X1

HIGH-PRECISION STEREO VIEWER
AND POINT TRANSFER DEVICE

The High-Precision Stereo Viewer and Point Transfer Device (Figure 6) is used to view both spooled film and film chips. The eyepiece assembly permits viewing in a variety of modes, such as stereo, reversed stereo, binocular monoscopic, 180 degrees upright reversion, and superimposed. Details on the operation and maintenance of this device can be found in the Operation and Maintenance Manual for Model 552 High-Precision Stereo Viewer and Point Transfer Device published by [redacted] A copy of this manual can be found in the same remote station as the "Point Transfer Device" you are using.

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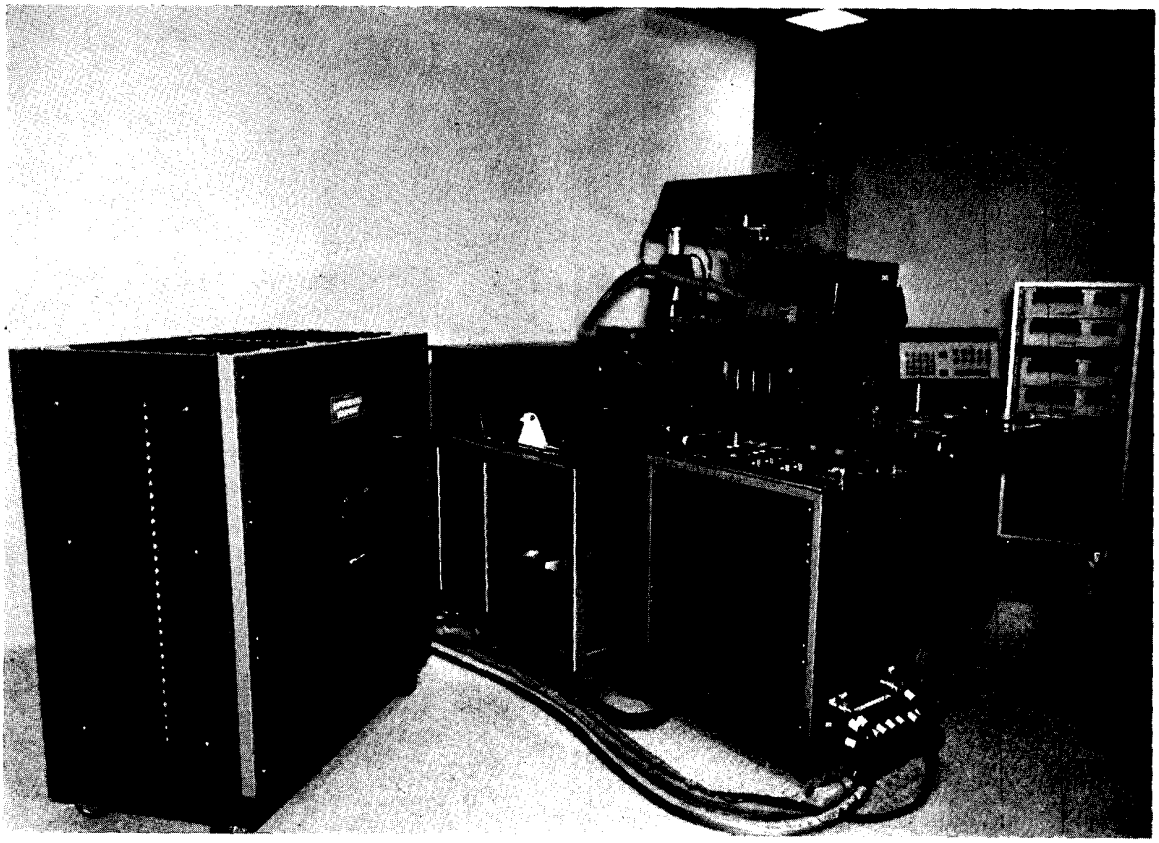

FIGURE 6. HIGH-PRECISION STEREO VIEWER AND POINT TRANSFER DEVICE.

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25X1 [redacted] STEREO COMPARATOR

25X1 The [redacted] Stereo Comparator (Figure 7) is used for measuring large pairs of stereoscopic photography. Film chips as large as 10 inches square and film strips up to 10 feet in length can be accommodated. Details on the operation and maintenance of this device can be found in Instruction and Maintenance Manual Type 1740A Stereo Comparator published by the [redacted] A copy of this manual can be found in the same remote station as the [redacted] Stereo Comparator you are using. 25X1

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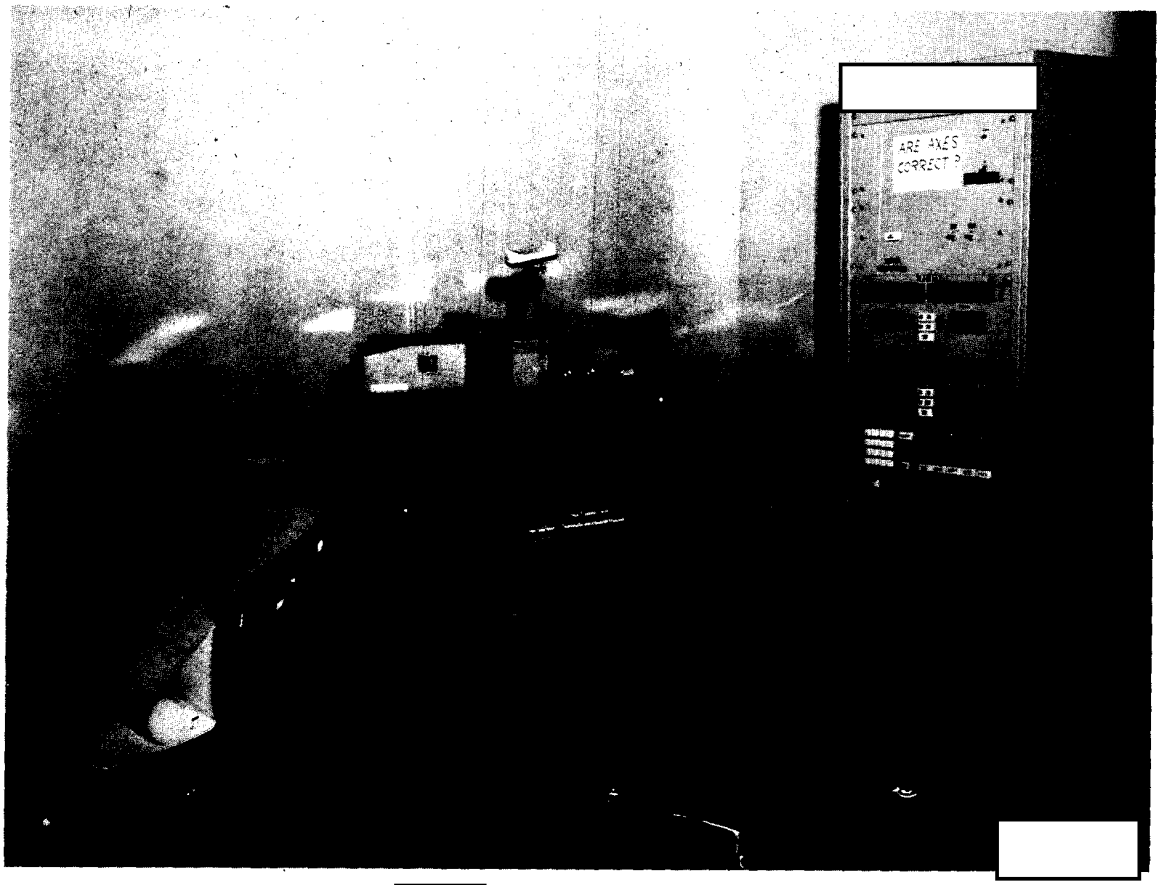

25X1 FIGURE 7. [redacted] STEREO COMPARATOR (TYPE 1740A).

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USER'S MANUAL

FOR THE

REAL-TIME MENSURATION PROGRAM

Second Edition

May 1973

Prepared by the

Automated Information Division

Production Services Group

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Comments and queries regarding this manual are welcomed. They may be directed to [redacted] NPIC/PSG/Automated Information Division, Code 143, [redacted]

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FIGURE 18. MARKING FIVE FIDUCIALS ON KH-7 PHOTOGRAPHY, EMULSION SIDE UP . . . . . IV- 44

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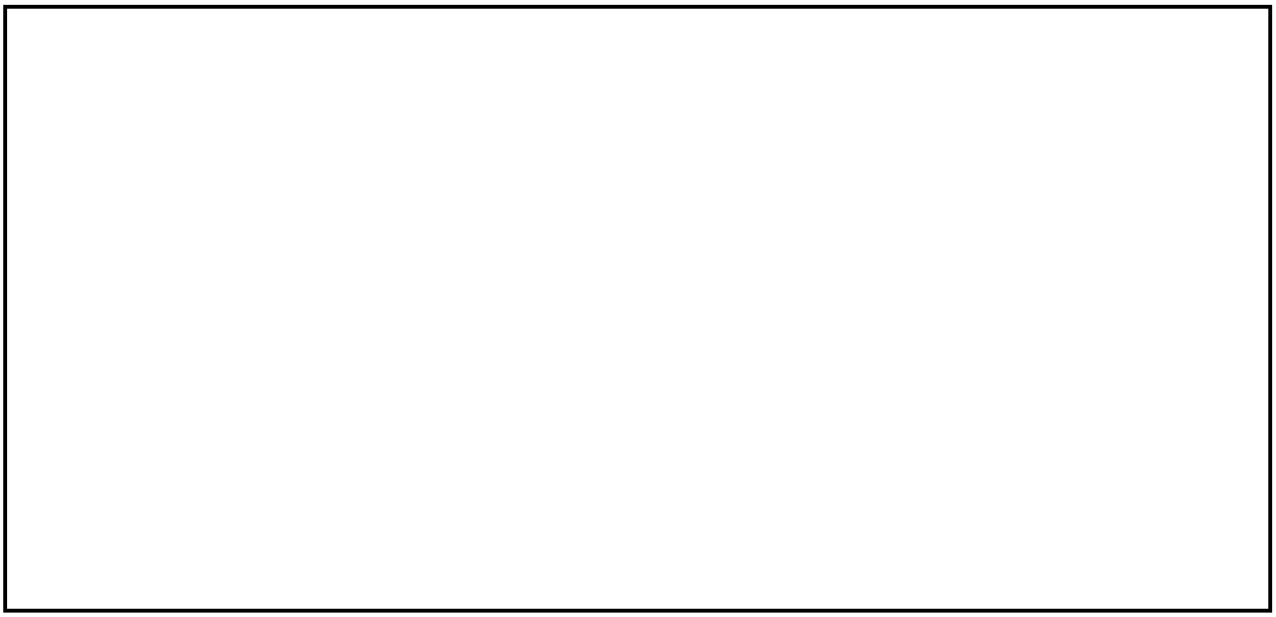

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TO THE USERS

The second edition of the USER'S MANUAL FOR THE REAL-TIME MENSURATION PROGRAM, [redacted] replaces the original manual of the same title, [redacted] which should be destroyed. Whenever necessary, the Real-Time Mensuration Program and the USER'S MANUAL FOR THE REAL-TIME MENSURATION PROGRAM will be modified to accommodate intelligence derived from other camera systems.

This manual explains how to use the Real-Time Mensuration Program and the related equipment. It also contains step-by-step instructions for measuring objects discernible on various kinds of imagery. However, this manual does not contain details on photogrammetric techniques. The subject matter is organized by camera system. Thus, for any given camera system, all available options and the procedures related to each appear in one chapter. However, the Appendix includes a discussion of two output functions, the s-azimuth and the z-azimuth, which were added to the program after copy for CHAPTER II, THE EQUIPMENT, had already been prepared for the printer.

This manual is not to be used with the AID publication, Remote Access Computer Service, third edition, March 1972.

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CHAPTER I. THE REAL-TIME MENSURATION PROGRAM

PURPOSE AND SCOPE

The Real-Time Mensuration Program (RTMP) calculates accurate measurements of objects discernible on the photography derived from the camera systems used by NPIC. The program can calculate distances, azimuths, geodetic coordinates, heights, and areas of objects visible on the film. In addition to these calculations, the program can create a plot of the objects being measured. The use of this capability is optional.

You use the program from your work area, which is referred to as a remote station. This station consists of at least a teletypewriter and a comparator; it may also include a plotter. All of this equipment is connected to, i.e., on line with, the UNIVAC 494 computer system. This equipment is used to send data to and receive data from that system. In general the RTMP requires that film be mounted on a comparator and identified via teletype messages. The points on which calculations are to be performed are then aligned under the comparator crosshairs and transmitted to the program. Within real time, the results of the calculations are printed via a teletypewriter.

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MENSURATION PARAMETERS FILE

The Mensuration Parameters File (MPF)* contains ephemeral data and mensuration parameters for KH-4B missions. The data for a given mission remains in the MPF for a period of six months. This data can be utilized by the RTMP to identify the characteristics of the photography being used. 25X1

The RTMP will automatically retrieve data from the MPF. If the ephemeral data for the photography being used is in the MPF, the program will search the file and retrieve the necessary parameters. The only parameters that must be input via a teletype will be those unique to the chip or frame being processed.

WHEN TO USE THE PROGRAM

At the present time, the Real-Time Mensuration Program is available weekdays at the times listed below. If these hours are changed, all affected components will be notified.

Monday	Tuesday	Wednesday	Thursday	Friday
0815-1830	0815-1830	0815-1830	0815-1830	0815-1830

To use the program outside these hours, complete an Operations Branch Work Request form, IP FM 340 (8/70), and submit it to the Production Analysis Section, Operations Branch, AID, (2N 800) before the program is needed. A sample work request appears on the next page.

* Formerly known as the Attitude and Position Catalog (APC).

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OPERATIONS BRANCH WORK REQUEST

TO: PRODUCTION ANALYSIS SECTION/OB/AID/PSG

PAS NO. (Leave blank)	COMPONENT CODE	PROJECT NO	JOB ID (Leave blank)		
	E70	143231		PAS	IN
REQUESTER	PHONE NO.	QUANTITY	TYPE RUN (Leave blank)		OUT
John Doe	[redacted]	NA			
PRODUCT				DEAD LINE	OUT 1 February 1973
SECURITY CLASSIFICATION (MUST BE COMPLETED BY REQUESTER)			TYPE FORM	CUST PICK UP	BADGE NO. OUT
NA			NA		
CONTROL NO.		WORK SHEETS	BURST		
NA		☐ YES ☒ NO	☐ YES ☒ NO		
TRIM		BIND		COS	IN
☐ RIGHT ☐ LEFT ☒ NEITHER		☐ LEFT ☐ TOP ☒ NEITHER			OUT

FOR PRODUCTION ANALYSIS SECTION USE ONLY

DATA CONTROLLER	DATE	SET UP TIME	BADGE NO.	DBS	IN
					OUT
SCHEDULER	494-A	494-B	1004	DIS	IN
					OUT
QUALITY CONTROLLER	INPUT DATE	CHECKTIME	BADGE NO.	EAM	IN
	OUTPUT DATE	CHECKTIME	BADGE NO.		OUT

JOB DESCRIPTION

Please load the Real-Time Mensuration Program for use between 0815 and 1630 on Saturday, 1 February 1973.

IP FM 340 (8/70)

[redacted] 25X1

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CHAPTER II. THE EQUIPMENT

ASR AND KSR TELETYPEWRITERS

Whenever you use the Real-Time Mensuration Program, you will use either an ASR or a KSR Model 35 teletypewriter to

* transmit to the computer parameters that will identify the film
* receive calculations produced by the program

TURN-ON PROCEDURES

Before a teletype can be used with the RTMP, it must be turned on. To turn on a teletype follow these procedures.

1. Turn the ON-OFF or MOTOR ON switch to ON.
2. If the teletype has a RYE/REAL TIME toggle switch, move it to the RYE position.
3. If the BREAK light is ON, press and release the BRK-RLS button; if it is not ON, omit this step.

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4. Press and release the ALT MODE key.

5. Press and hold the CTRL key.

6. Press and release the Y key.

7. Press and release the G key.

8. Release the CTRL key.

If the computer is functioning properly and this teletype is currently communicating with the RTMP, you will receive this message:

LEN T RTM READY

If this message does not appear, try again later.

If the turn-on sequence listed above were summarized, it could be presented in this manner.

Turn teletype on
Move RYE/REAL TIME (if any) to RYE
Press BRK-RLS (if applicable)
ALT MODE
CTRL (hold)
Y
G

CONVERTING A TELETYPE

Certain teletypes are used primarily for the RTMP. These teletypes are normally in a technical mode; other teletypes are in an analytic mode. However, teletypes that are normally in a technical mode can also be used in an analytic mode. If your teletype has been used in an analytic mode, you will receive no teletype messages when you try to use the RTMP. If this happens, reconvert the teletype to the technical mode so that it can again be used with the RTMP.

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To do this press these keys:

ALT MODE
CTRL + Y (SVC)
CTRL + G (BELL)

You will receive this message indicating that the conversion is complete:

LEN T RTM READY

This procedure may also be used to effect the conversion:

ALT MODE
CTRL + Y
T+LOGICAL EQUIPMENT NUMBER
(e.g., T112)

You will receive this message when the conversion has been completed:

TLOGICAL EQUIPMENT NUMBER

COMPARATORS

Whenever you use the RTMP, you will use a comparator to

* locate points of interest on a photograph
* determine the x and y coordinates of selected points of interest
* transmit these values to the program

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25X1

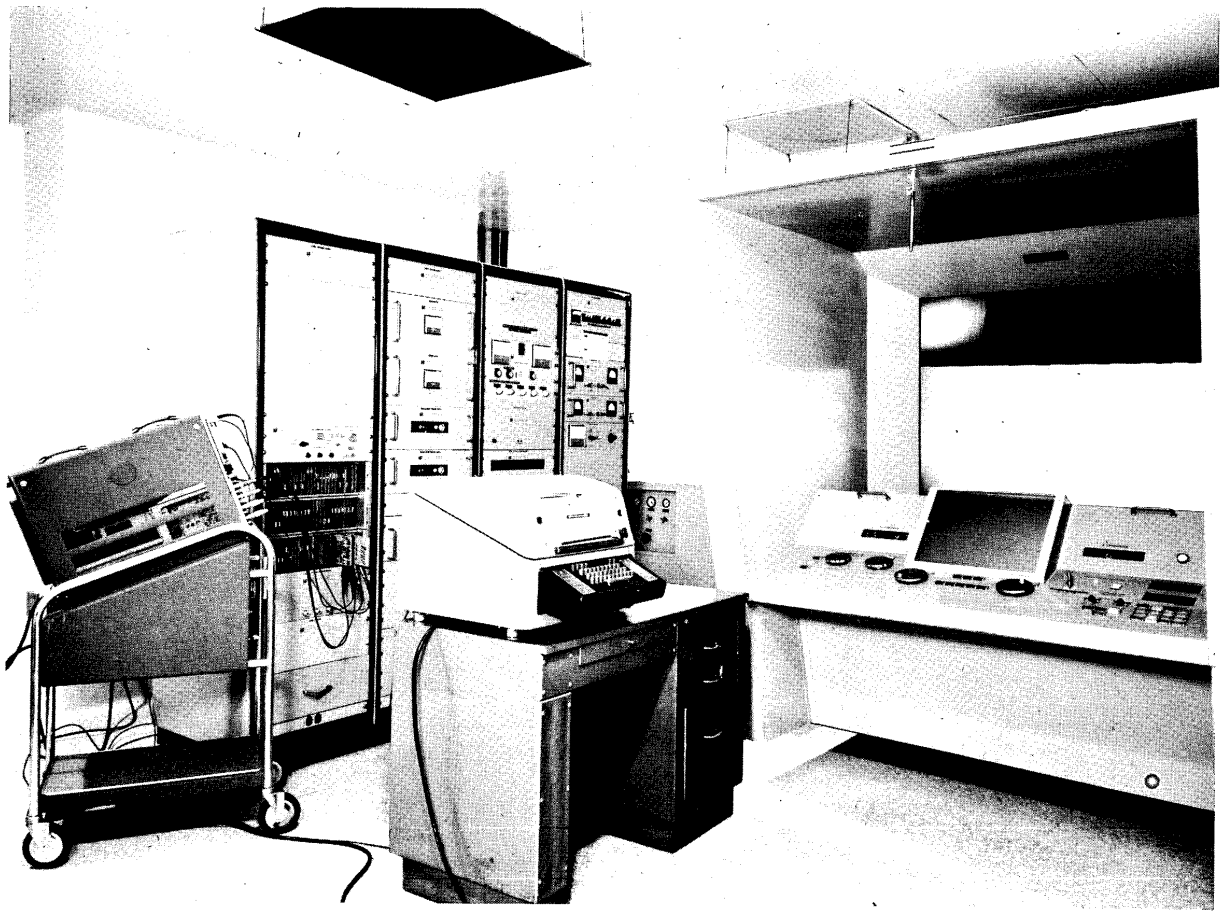

FIGURE 1. [redacted] DUAL-SCREEN MEASURING PROJECTOR.

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[redacted] DUAL-SCREEN
MEASURING PROJECTOR

The [redacted] Dual-Screen Measuring Projector (Figure 1) has two screens upon which images are projected. The large screen is used for scanning; the small screen, for measuring. The [redacted] has a main console and an auxiliary console. The main console is used for projecting images; the auxiliary console, for power.

25X1

Parts of Main Console

The parts of the main console and their respective functions are given in Table 1.

Table 1. [redacted] Main Console Parts and Functions

Part	Function
Y-COORDINATE & X-COORDINATE windows	Display relative coordinates in microns of point under crosshairs on small screen
RESET button	Causes both coordinates to be set at 500,000 counts; does not move film
RETICLE BRILLIANCE switch	Adjusts intensity of reticle to desired illumination
FILM SLEW wheel	Permits film advancement to new frame in either direction
LOW, MEDIUM, & HIGH buttons	Determine speed at which FILM SLEW wheel will advance film

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Table 1. [redacted] Main Console Parts and Functions (Continued)

Part	Function
ADVANCE-CLAMP button	In CLAMP position when mensuration is being done; automatically returns to ADVANCE position when FILM SLEW wheel is turned; returns to CLAMP position when FILM SLEW wheel is released
FRAME CENTER button	Causes crosshairs of small screen to be over center of stage; x & y coordinates are changed to accommodate all stage movement
RETICLE wheel	Rotates reticle of small screen
Y DOWN LIMIT & UP LIMIT lights; X LEFT LIMIT & RIGHT LIMIT lights	Indicate stage has reached its movement limit & must be moved in opposite direction
Y wheel	Moves stage toward or away from front of main console
X wheel	Moves optics to right or left
DATA RECORD buttons	Used for transmitting points to program
TRANSMISSION FAILURE light	Indicates failure in transmitting points; must be pressed before additional points can be transmitted
TRANSMISSION light	Indicates point is being sent to program

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Table 1. [redacted] Main Console Parts and Functions (Continued)

Part	Function
INTERLOCK FAILURE light	Indicates ON button at rear of main console is on & must be turned off
X-Y SLEW handle	Permits movement of stage & optics even though you do not turn X or Y wheel
FOCUS switch	Adjusts film focus to desired position
ILLUMINATION CONTROLS	Adjusts lighting on large screen (coarse adjustment) or small screen (fine adjustment)
MAGNIFICATION lights	Indicate magnification on small screen
ADVANCE switch	Allows magnification to be changed
ROTARY SWITCHES	Used to send control numbers with coordinates
INDICATIVE FUNCTION buttons	Used to determine output from RTMP; sometimes referred to as output function buttons

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Turn-On Procedures

If the [redacted] has been turned off for any reason, complete these turn-on procedures. On the auxiliary console,

1. Check the reading of the two meters located in the SERVOMOTOR AMPLIFIER area. Both of the meters must read less than 50 milliamperes.

2. In the CIRCUIT BREAKERS area, move the Servo H.V. and the Vacuum Pump toggle switches to the ON position.

3. In the CURRENT ADJUST area, move the toggle switch to the OPERATING position.

Most of these switches may be left on until the end of a working day. However, you should turn the Vacuum Pump switch off after using the [redacted]

Mounting The Film

To mount film on an [redacted] follow these steps in the order listed. At the rear of the main console,

1. Press the ON button.

2. Press the ADVANCE-CLAMP button until the ADVANCE portion lights up.

3. Press the SLEW-LOAD button until the LOAD portion lights up.

4. Mount the film on the stage.

5. Press the SLEW-LOAD button until the SLEW portion lights up.

6. Using the FILM SLEW dial, advance the film to the desired frame.

7. Press the ADVANCE-CLAMP button until the CLAMP portion lights up.

8. Press the ON button; the light will go out.

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X1 [redacted] COMPARATOR 25X1

There are several different models of a [redacted] comparator in [redacted] 25X1
X1 [redacted] One of these models, 1210, appears in Figure 2. On a [redacted] compara- 25X1
tor film is viewed through a binocular optical system. As the light rays pass through the film, they are magnified and reflected into the eyepieces. This comparator consists of a main console and an electronic module. The main console is used for viewing film and determining relative coordinates. The electronic module is used to display relative x and y coordinates and to transmit points to the program.

Parts of Comparator

X1 The parts of a [redacted] comparator and their respective functions are
X1 listed in Table 2. All [redacted] comparators [redacted] have these parts. 25X1

X1 Table 2. [redacted] Comparator Parts and Functions

Part	Function
	MAIN CONSOLE
Stage	Platform on which film is placed
Platen	Holds film in position on stage
Optics	Used to magnify & focus image

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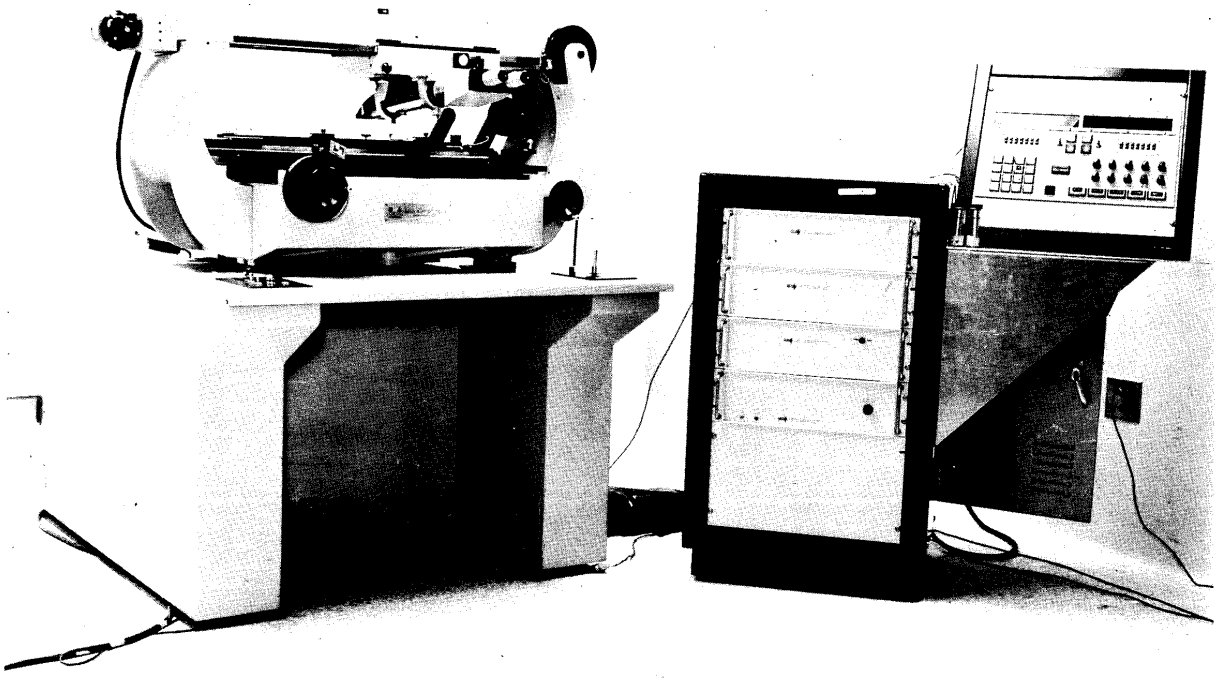

FIGURE 2. [redacted] COMPARATOR, MODEL 1210.

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X1 Table 2. [redacted] Comparator Parts and Functions (Continued)

Part	Function
FIELD BRIGHTNESS dial	Adjusts small area light on film
X-axis wheel	Moves stage; permits adjustment of x coordinate
Y-axis wheel	Moves optics; permits adjustment of y coordinate
Slew handle	Permits simultaneous movement at variable speed in x & y directions
X and Y SAFETY LIMIT lights	Indicate movement in x or y direction has reached its limit; direction of movement must be reversed
Plate focus wheel	Permits adjustments of film focusing
Reticle focus wheel	Focuses reticle to desired point
Eyepiece	Used to balance focusing to both eyes
Zoom dial	Increases magnification from 1 to 2 times over the selected magnification
ELECTRONIC MODULE	
X AXIS and Y AXIS windows	Display relative x & y coordinates of point under crosshairs

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Table 2. [redacted] Comparator Parts and Functions (Continued)

Part	Function
PRESET RESET buttons	Change x & y axis values to values indicated on PRESET RESET number wheels
ZERO RESET buttons	Change x & y axis values to zero (Ø)
PRESET RESET number wheels	Used with PRESET RESET buttons for changing coordinate values
DIRECTION toggle switches	Used to rotate x-axis or y-axis by 180°
INSTRUCTION CHARACTER buttons (16)	Used to determine output from RTMP; sometimes referred to as output function buttons
ROTARY SWITCHES	Used to send control numbers with coordinates
READOUT CHARACTER buttons	Used to transmit points to program
SUBSTAGE light	Illuminates platen for general viewing
TRANSMISSION light	Indicates data is being transmitted to program
ALARM RESET button	Lights & activates buzzer whenever transmission error occurs; must be pressed after error has occurred to deactivate buzzer & to transmit more data

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Turn-On Procedures

25X1 If the [redacted] comparator you want to use has been turned off for any reason, complete these turn-on procedures.

On the main console,

1. Move the POWER toggle switch to the ON position.
2. Move the SUBSTAGE switch to the ON position.
3. Wait until the power light on the main console comes on.

On the electronic module,

1. If the electronic module is equipped with a PUNCH/COMPUTER toggle switch, move it to the COMPUTER position.
2. Move the POWER switch to the OFF position.
3. Move the SYSTEM MODE dial to the TWO-AXIS position.

Mounting The Film

The procedures for mounting film on a [redacted] comparator are the following: 25X1

1. Press the FILM PLATEN button. This will activate the electromagnets on the platen and separate the plates of glass.
2. Insert the film between the two plates of glass.

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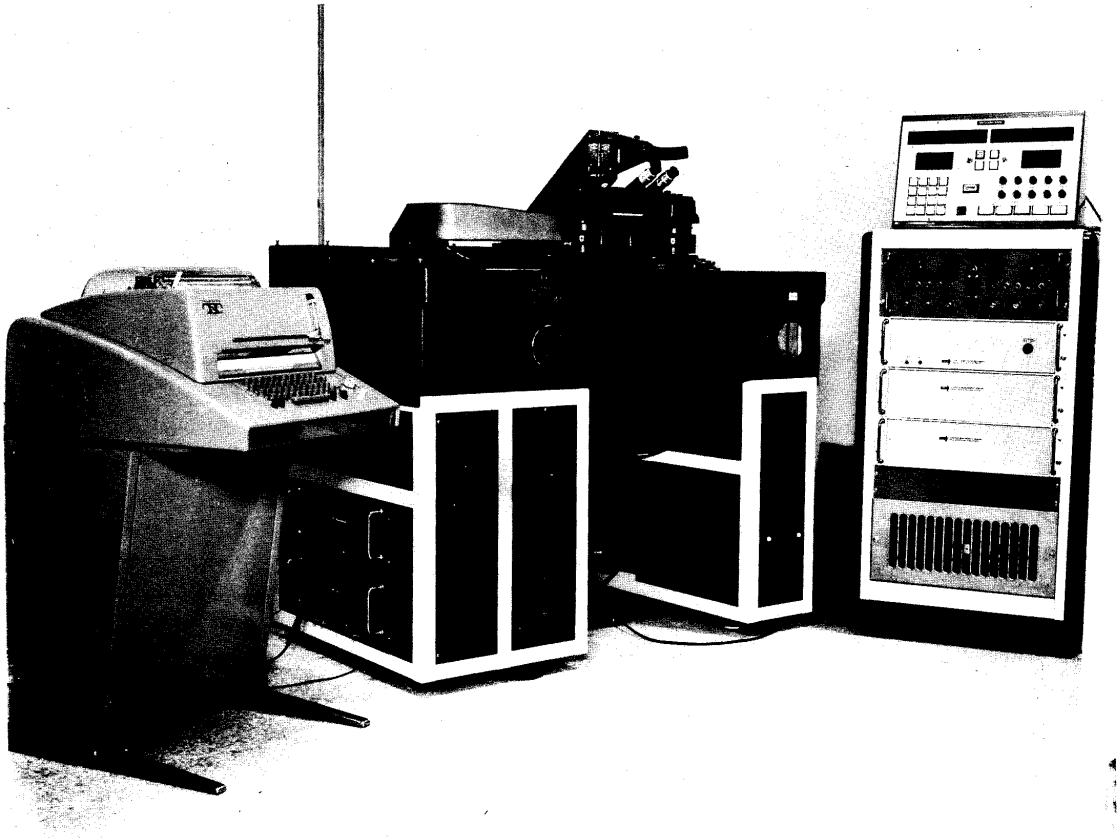

FIGURE 3. [redacted] STEREO CHIP COMPARATOR.

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STEREO CHIP COMPARATOR

The Stereo Chip Comparator or Chip comparator (Figure 3) permits stereo viewing by means of a binocular optical system and two pieces (chips) of photography. Measurements are performed on only one chip; the other is for viewing only.

The Chip comparator has two principal components: a main console and an electronic module. The main console is used for viewing and determining relative coordinates. The electronic module is used to

* control the photo environment, i.e., adjust the lighting, color, etc.
* display x and y coordinates
* transmit points to the program

Parts of Comparator

The parts of a Chip comparator and their respective functions are listed in Table 3 on the next page.

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Table 3. Chip Comparator Parts and Functions

Part	Function
MAIN CONSOLE	
Y AXIS drive	Moves stages toward front or rear of comparator; gross movements
Y AXIS hand wheel	Moves stages toward front or rear of comparator; fine movements
X AXIS drive	Moves stages to right or left; gross movements
X AXIS hand wheel	Moves stages to right or left; fine movements
AUTO-COMPENSATOR Y AXIS & X AXIS toggle switches	Activate auto-compensator
X-READY and Y-READY lights	Indicate power has reached operation level
Left stage	Holds chip to be measured
Right stage	Holds second chip for stereo viewing; may be moved by hand for gross adjustments or by screws for fine adjustments
Height adjustment dial	Used for gross focus adjustments

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Table 3. Chip Comparator Parts and Functions (Continued)

Part	Function
Zoom dial	Increases magnification from 1 to 2 times
Rotation dials	Rotate viewed images without rotating chips
Elevation adjustment switch	Permits comfortable positioning of optics
Interpupillary distance gauge	Increases or decreases distance between eyepieces
Eyepieces	Used for fine focus adjustments
Reticle adjustment dial	Used to focus reticle
ELECTRONIC MODULE CONTROL PANEL	
SPOT INT LEFT & RIGHT dials	Increase illumination for left & right stages
LEFT & RIGHT FILTER SELECTOR dials	Permit colors of light to be passed through film
Power light	Indicates MAIN POWER switch is ON
SPOT LT & SPOT RT toggle switches	Determine amount of light passed through film when concentrated light beam is used
SPOT LEFT & SPOT RIGHT toggle switches	Permit use of a concentrated beam

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Table 3. Chip Comparator Parts and Functions (Continued)

LEFT & RIGHT GEN ILL toggle switches	Illuminate entire stage
PUMP toggle switch	Activates vacuum pump
VAC LEFT & VAC RIGHT toggle switches	Create suction to film on stages
VAC PLATEN switch	Creates suction to stabilize right stage
ELECTRONIC MODULE: TRANSMISSION PANEL	
X AXIS & Y AXIS windows	Display relative x & y coordinates of point on film under crosshairs
PRESET RESET buttons	Change x & y axis values to values indicated on PRESET RESET number wheels
ZERO RESET buttons	Change x & y axis values to zero (Ø)
PRESET RESET number wheels	Used with PRESET RESET buttons for changing coordinate values
DIRECTION toggle switches	Used to rotate x-axis or y-axis by 180°
INSTRUCTION CHARACTER buttons (16)	Used to determine output; also referred to as output function buttons
ROTARY SWITCHES	Used to send control numbers with coordinates
READOUT CHARACTER buttons	Used to transmit points to program

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Table 3. Chip Comparator Parts and Functions (Continued)

Part	Function
TRANSMISSION light	When illuminated, indicates data is being transmitted to program
ALARM RESET button	Lights & activates buzzer whenever transmission error occurs; must be pressed after error has occurred to deactivate buzzer & to transmit more data

Turn-On Procedures

If the chip comparator you want to use has been turned off for any reason, complete these turn-on procedures.

1. Move the MAIN POWER switch on the control panel to the ON position.
2. If the electronic module is equipped with a PUNCH/COMPUTER toggle switch, move it to the COMPUTER position.
3. Move the X AXIS and the Y AXIS POWER switches to the ON position. These switches are located on the lower left-hand side of the main console.
4. Wait until the X-READY and Y-READY lights on the front of the main console come on. This will usually take about 30 minutes.

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Compensating
A Comparator

On a chip comparator it is necessary to make adjustments to stabilize the x and y coordinates. This process is known as compensating a comparator. You should compensate a chip comparator every morning before it is used. The procedures for compensating a comparator are the following:

1. Press the X AXIS LEFT drive until movement reaches its limit and the stage stops.
2. Press the Y AXIS IN drive until movement reaches its limit and the stage stops.
3. Zero reset the x and y coordinates.
4. Move the X AXIS AUTO COMPENSATOR toggle switch to the ON position.
5. Press the X AXIS RIGHT drive and allow the stage to move about two inches.
6. Release the X AXIS RIGHT drive and immediately press the X AXIS LEFT drive.
7. When the stage reaches its movement limit, release the X AXIS LEFT drive.
8. Move the X AXIS AUTO COMPENSATOR toggle switch to the OFF position.
9. Move the Y AXIS AUTO COMPENSATOR toggle switch to the ON position.
10. Press the Y AXIS OUT drive and allow the stage to move about two inches.
11. Release the Y AXIS OUT drive and immediately press the Y AXIS IN drive.

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12. When the stage reaches its movement limit, release the Y AXIS IN drive.

13. Move the Y AXIS AUTO COMPENSATOR toggle switch to the OFF position.

Placing The Chips

Placing the chips on a chip comparator involves these steps in the order listed.

1. Place the chip to be measured on the left stage.

2. Move the PUMP toggle switch to the ON position.

3. Move the VAC LEFT toggle switch to the ON position.

4. If you want stereo viewing, place the second chip on the right stage.

5. Move the VAC RIGHT to the ON position.

X1 [redacted] MICRON MENSURATION STAGE

X1 The [redacted] Micron Mensuration Stage or [redacted] Comparator (Figure 4) is a relatively simple device that resembles a microscope. Depending on the optics selected, it can be used for either mono or stereo viewing. The X1 [redacted] comparator consists of a viewing unit, an electronic module, and a control cabinet. The viewing unit is used for placing and viewing the chip(s). The electronic module records the movement of the film and transmits information to the program. The control cabinet contains the power switches for the device. 25X1

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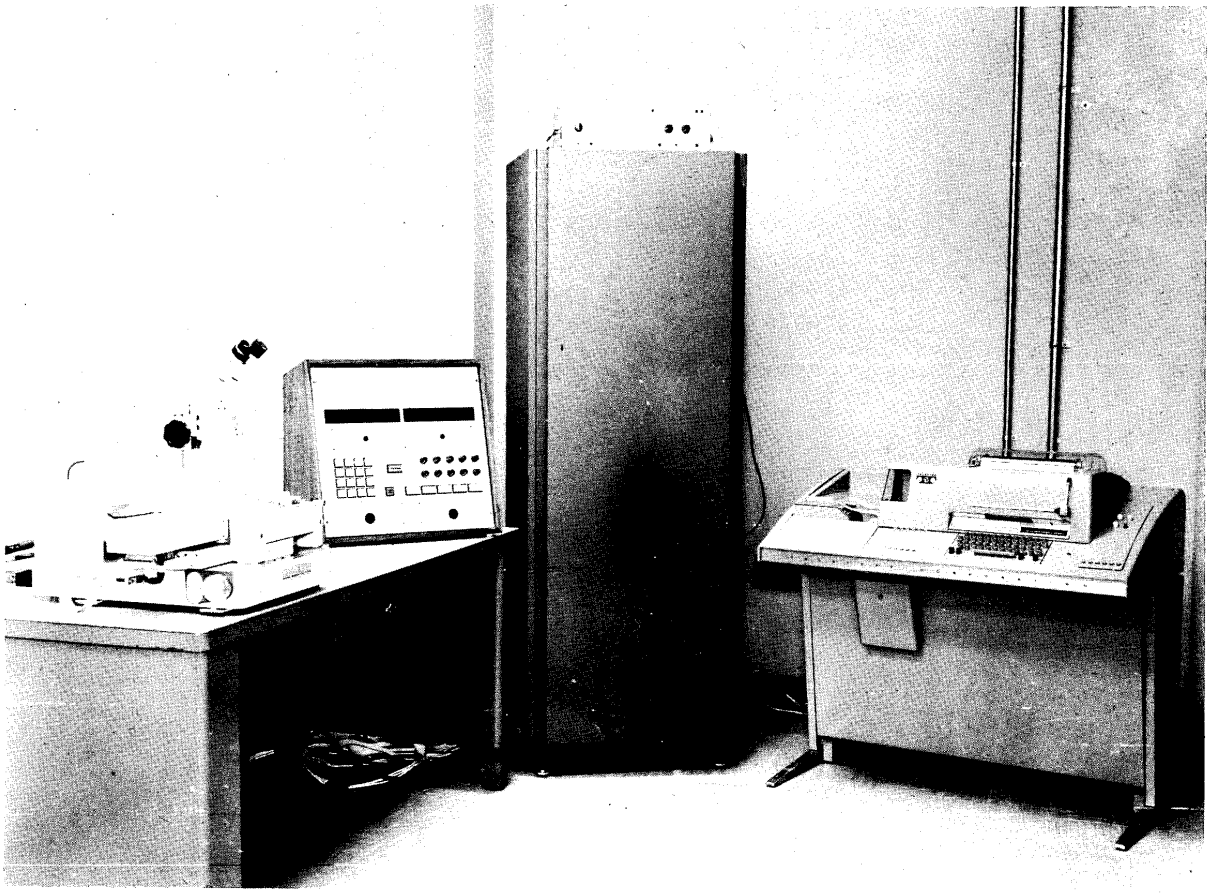

FIGURE 4. [redacted] MICRON MENSURATION STAGE.

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Parts of Comparator

X1 The parts of a [redacted] comparator and their respective functions are listed in Table 4.

X1 Table 4. [redacted] Comparator Parts and Functions

Part	Function
	VIEWING UNIT
X-AXIS control knob	Permits fine adjustments in x direction
Y-AXIS control knob	Permits fine adjustments in y direction
Magnification control	Permits change in magnification
Field brightness dial	Permits adjustment of light passing through film
Ready light	Indicates power has reached operational level
Lock switch	Locks stage in current position
Film clips	Used to secure film to stage
Focus control knob	Permits fine focusing adjustments
	ELECTRONIC MODULE
X-AXIS & Y-AXIS windows	Display relative x & y coordinates of point on film under crosshair

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Table 4. [redacted] Comparator Parts and Functions (Continued)

Part	Function
INSTRUCTION CHARACTER buttons (16)	Used to determine output; also referred to as output function buttons
ROTARY SWITCHES	Used to send control numbers with coordinates
READOUT CHARACTER buttons	Used to transmit points to program
X & Y range lights	Indicate movement limits in x & y directions
X & Y range speakers	Buzz when x & y movement limits are reached
TRANSMISSION light	When illuminated, indicates data is being transmitted to program
ALARM RESET button	Lights & activates buzzer whenever transmission error occurs; after an error, must be pressed to deactivate buzzer

Turn-On Procedures

If the [redacted] comparator has been turned off for any reason, complete these turn-on procedures.

1. Turn the main power switch in the control cabinet on.
2. When the Ready light (on the viewer unit) lights, turn the [redacted] Power Unit switch in the control cabinet on.

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Placing
The Chips

X1 Placing the chip(s) on a [redacted] comparator involves these steps in the order listed.

1. Place the chip(s) on the stage of the viewing unit.

2. Using the film clips, clamp the film down.

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HIGH-PRECISION-STEREO COMPARATOR

The High-Precision-Stereo Comparator (HPSC) appears in Figure 5. This device permits stereo viewing of frame, panoramic, and strip stereoscopic photography. For information on the operation and maintenance of this device see the following manuals which are kept in the HPSC remote station --

* Stereocomparator Operator's Manual,
* Systems and Stereo Comparator Program Documentation, Section 4, "Operations,"
* Computer Program Specifications and Instructions,

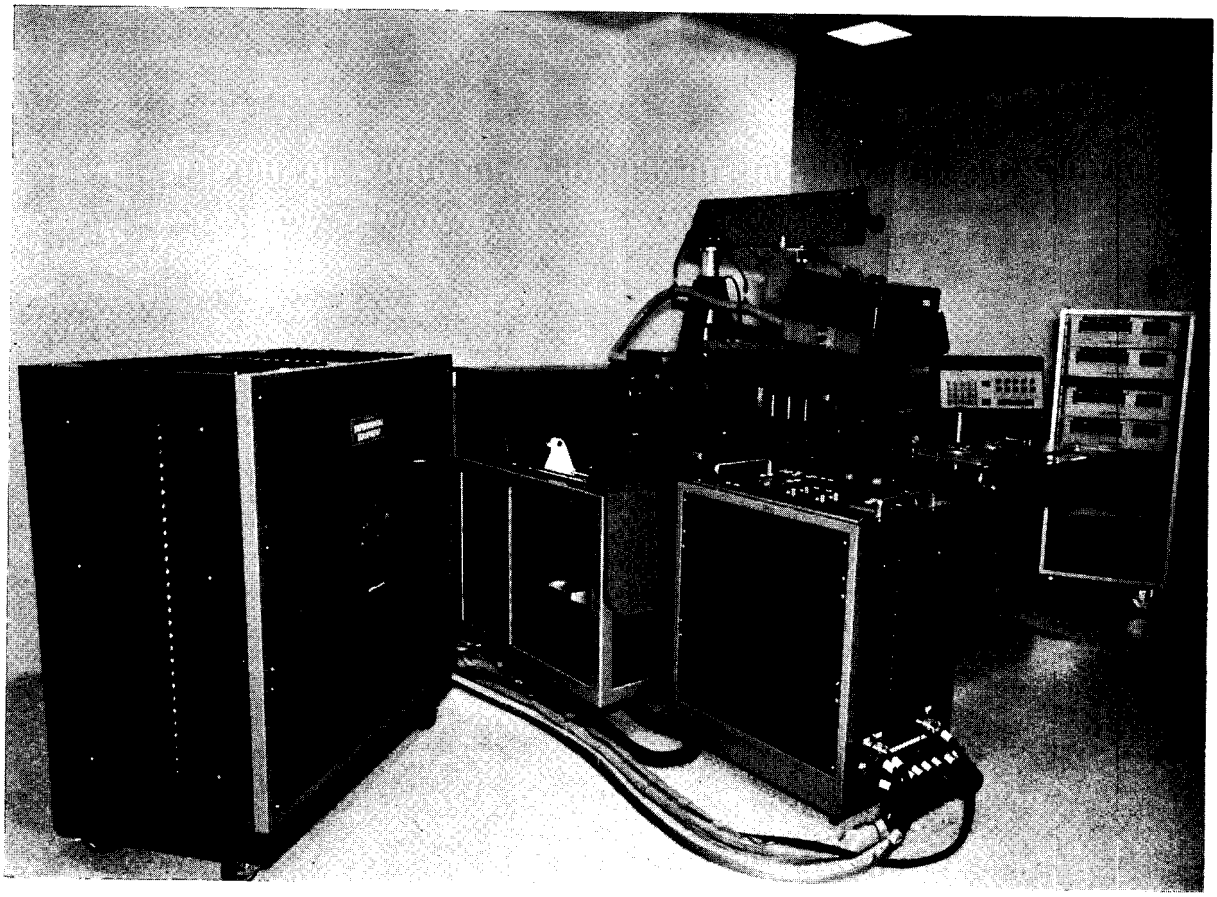

FIGURE 5. HIGH-PRECISION-STEREO COMPARATOR.

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HIGH-PRECISION STEREO VIEWER
AND POINT TRANSFER DEVICE

The High-Precision Stereo Viewer and Point Transfer Device (Figure 6) is used to view both spooled film and film chips. The eyepiece assembly permits viewing in a variety of modes, such as stereo, reversed stereo, binocular monoscopic, 180 degrees upright reversion, and superimposed. Details on the operation and maintenance of this device can be found in the Operation and Maintenance Manual for Model 552 High-Precision Stereo Viewer and Point Transfer Device published by [redacted] A copy of this manual can be found in the same remote station as the "Point Transfer Device" you are using.

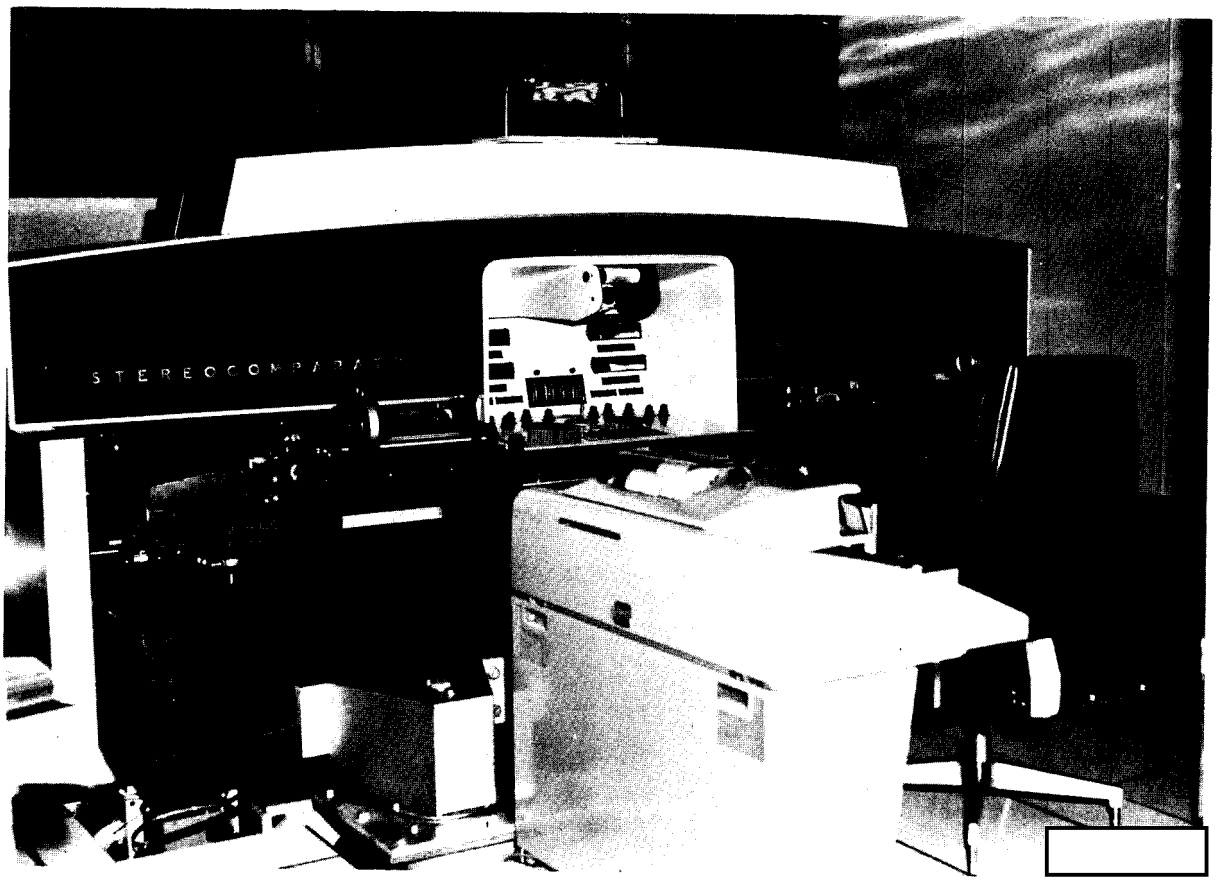

FIGURE 6. HIGH-PRECISION STEREO VIEWER AND POINT TRANSFER DEVICE.

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STEREO COMPARATOR

The Stereo Comparator (Figure 7) is used for measuring large pairs of stereoscopic photography. Film chips as large as 10 inches square and film strips up to 10 feet in length can be accommodated. Details on the operation and maintenance of this device can be found in Instruction and Maintenance Manual Type 1740A Stereo Comparator published by the A copy of this manual can be found in the same remote station as the Stereo Comparator you are using.

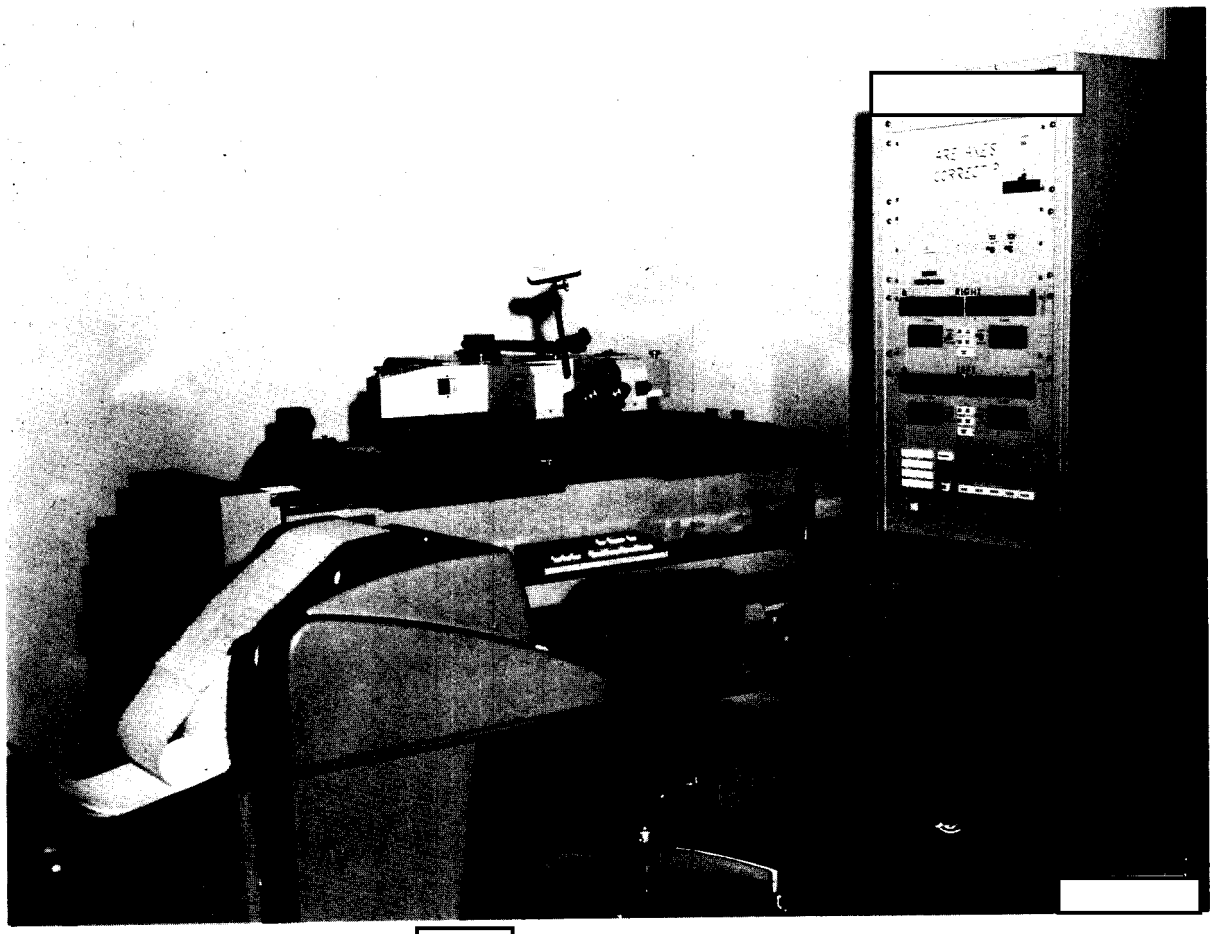

FIGURE 7. STEREO COMPARATOR (TYPE 1740A).

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TWIN STAGE ON-LINE
COMPARATOR

The Twin Stage On-Line Comparator (Figure 8) is used to measure pairs of stereoscopic photography. Film chips up to 6 inches square can be accommodated. Details on the operation and maintenance of this device can be found in Instruction and Maintenance Manual Type 1740 Twin Stage On-Line Comparator published by the [redacted] A copy of this manual can be found in the same remote station as the Twin Stage On-Line Comparator you are using.

FIGURE 8. TWIN STATE ON-LINE COMPARATOR.

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USING THE TRANSMISSION BUTTONS

There are five buttons on a comparator which you will use to transmit points to the program. These buttons are labeled FIDUCIAL, INITIAL, INTERMEDIATE or NORMAL, TERMINAL, and MULTIPLE or ERROR. On an [redacted] they appear on the main console in the area marked DATA RECORD. On a Chip, [redacted] comparator they appear on the transmission panel of the electronic module in the area marked READOUT CHARACTERS. For the location of the transmission buttons on a stereo comparator, see the instruction manual for the particular stereo comparator you are using. How to use the transmission buttons is explained in Table 5.

Table 5. How To Use the Transmission Buttons

Button	How To Use
FIDUCIAL	During comparator initialization, to transmit film reference points to establish coordinate system
	After all output is received, to terminate frame operations
INITIAL	To begin new sequence of points; previous points disregarded
	In options using variable filmspeed, to transmit point required for determining measured filmspeed
	For plotter initialization, to transmit points to establish plot origin and scale
	For stereo options, to transmit points to obtain relative orientation of two frames or chips of photography
	When using the CIRCLE output function, to transmit points on the circumference of a circle
	When using the CYLINDER or CYLINDER SHADOW output functions, to transmit points on each side of the cylinder or cylinder's shadow

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USING THE TRANSMISSION BUTTONS

There are five buttons on a comparator which you will use to transmit points to the program. These buttons are labeled FIDUCIAL, INITIAL, INTERMEDIATE or NORMAL, TERMINAL, and MULTIPLE or ERROR. On an [redacted] they appear on the main console in the area marked DATA RECORD. On a Chip, [redacted] comparator they appear on the transmission panel of the electronic module in the area marked READOUT CHARACTERS. For the location of the transmission buttons on a stereo comparator, see the instruction manual for the particular stereo comparator you are using. How to use the transmission buttons is explained in Table 5.

Table 5. How To Use the Transmission Buttons

Button	How To Use
FIDUCIAL	During comparator initialization, to transmit film reference points to establish coordinate system
	After all output is received, to terminate frame operations
INITIAL	To begin new sequence of points; previous points disregarded
	In options using variable filmspeed, to transmit point required for determining measured filmspeed
	For plotter initialization, to transmit points to establish plot origin and scale
	For stereo options, to transmit points to obtain relative orientation of two frames or chips of photography
	When using the CIRCLE output function, to transmit points on the circumference of a circle
	When using the CYLINDER or CYLINDER SHADOW output functions, to transmit points on each side of the cylinder or cylinder's shadow

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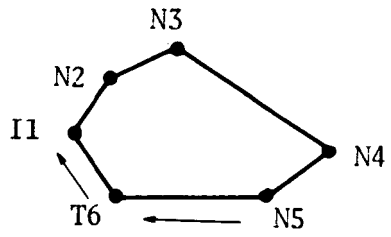
Table 5. How To Use the Transmission Buttons (continued)

Button	How To Use
INTERMEDIATE OR NORMAL	In options using variable filmspeed, to correct errors in transmission of I points required for determining measured filmspeed In options using stereo photography, to correct errors in transmission of I points required for obtaining relative orientation of two frames or chips of photography When using CIRCLE, CYLINDER, or CYLINDER SHADOW output functions, to delete I point erroneously transmitted
TERMINAL	To terminate a sequence of points as in * closing a polygon In a sequence countaining an I point, several N points, & a T point, transmission of T will cause calculations to be performed from last N to T & then from T to I



* In the illustrations the points are numbered in the order in which they may be transmitted. Designators for the points are: F = fiducial, I = initial, N = intermediate or normal, T = terminal, and M = multiple.

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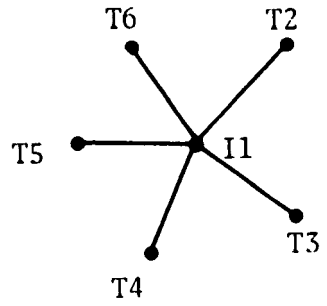
Table 5. How To Use the Transmission Buttons (continued)

Button	How To Use
TERMINAL (cont.)	* spoking In a sequence containing an I point & several T points, calculations are performed from I to each T; no calculations are performed from one T point to another



To indicate end of transmission of time marks to be used for determining measured filmspeed; variable filmspeed options only

To indicate end of transmission of points for obtaining relative orientation of two frames or chips of photography; stereo options only

To indicate the end of transmission of points for CIRCLE, CYLINDER, & CYLINDER SHADOW output functions

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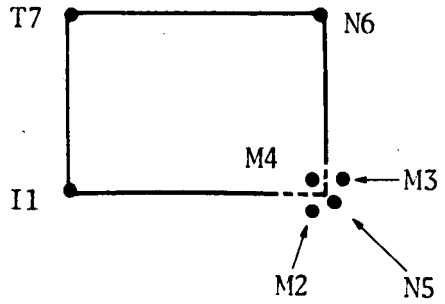
Table 5. How To Use the Transmission Buttons (continued)

Button	How To Use
MULTIPLE	To obtain measurements with points which can only be estimated; if a point is indefinite, a series of approximate points can be sent as M points; after sending M points, send appropriate point, i.e., I, N, or T; M points plus I, N, or T are geometrically averaged to produce 1 point; calculations performed on averaged point as though transmitted with specified designator



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USING THE OUTPUT FUNCTION BUTTONS

Every comparator used with the RTMP has an array of 16 buttons used to determine output. These buttons appear on the main console of an [redacted] in the area marked INDICATIVE FUNCTIONS. On a Chip, [redacted] comparator they are located on the transmission panel of the electronic module and are marked INSTRUCTION CHARACTERS. If you are using any of the stereoscopic comparators described earlier, see the instruction manual for the particular comparator you are using. 25X1 25X1

The number of output functions can be increased ten times by using the first rotary switch which is located on the electronic module of all comparators except the HPSC. (See the HPSC instruction manuals located in the HPSC remote station.) Each of the ten settings, Ø through 9, of this rotary switch has the capability of giving an alternate meaning to the array of output function buttons. However, only four settings, Ø through 3, are presently in use. The settings of Ø and 2 are used for monoscopic operations; 1 and 3 for stereoscopic operations. The output functions used most frequently are available for each of the four settings. Figures 9-12 illustrate the output functions available for rotary switch settings Ø through 3.

You must select the correct rotary switch setting and then press the appropriate output function button(s) for the computations you want before you transmit a sequence of points. Several output function buttons may be pressed concurrently to obtain various calculations for one sequence of points. After you receive the output for a given sequence of points, you may release the output function button(s), change the rotary switch setting, and press the appropriate output function button(s) for the next sequence of points. The output function buttons are explained in Table 6.

OBTAINING MENSURAL OUTPUT

How to use the output function buttons and the transmission buttons to obtain mensural output is explained in Table 7.

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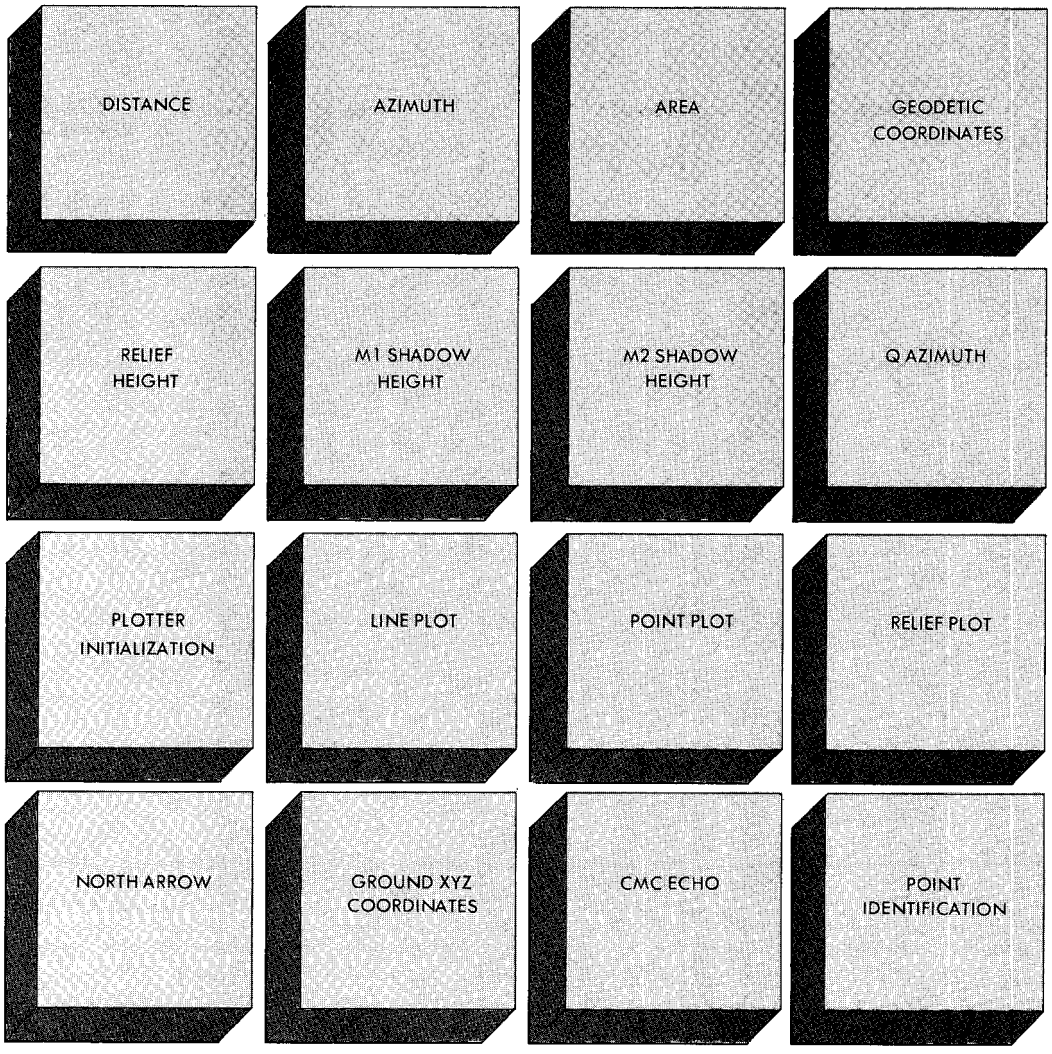

FIGURE 9. OUTPUT FUNCTION BUTTONS WITH ROTARY SWITCH SETTING AT Ø (for monoscopic operations).

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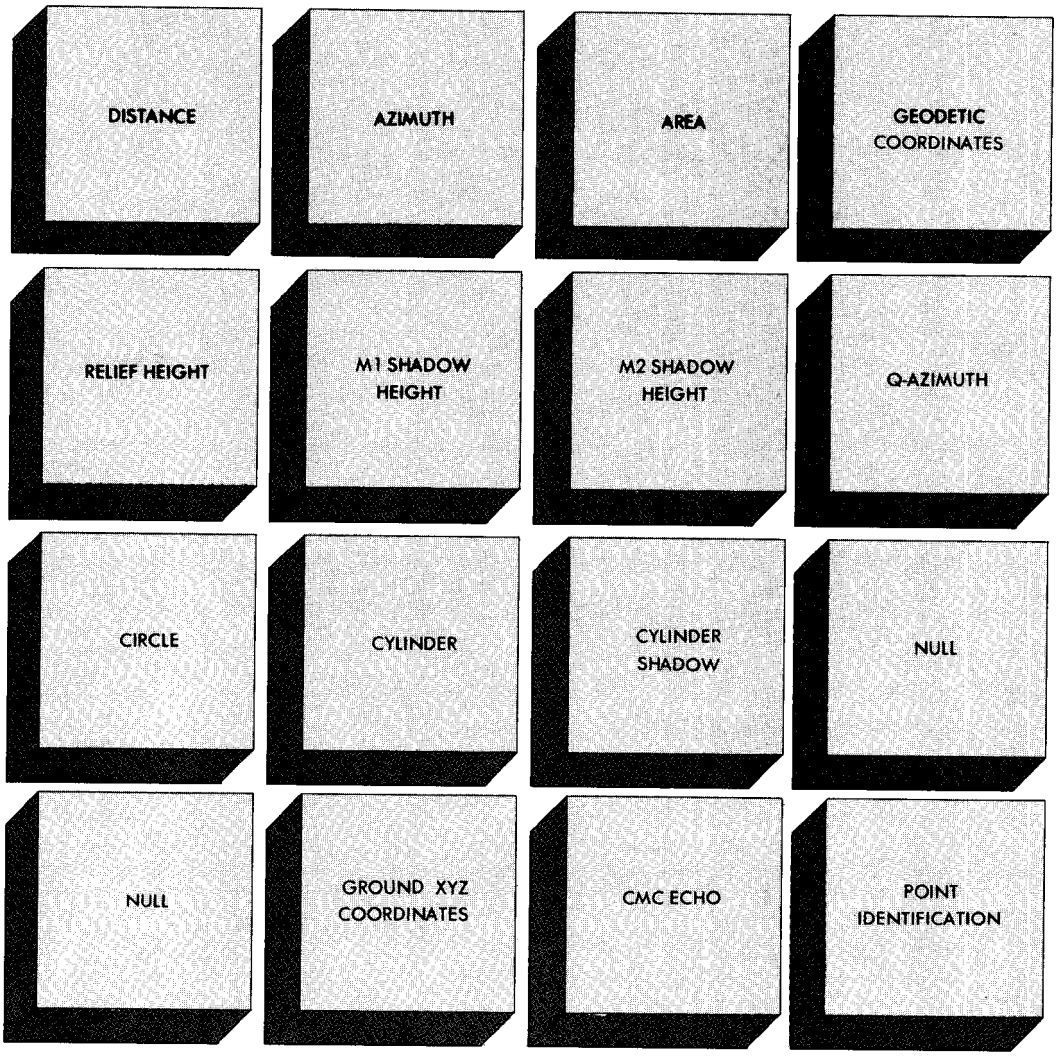

FIGURE 10. OUTPUT FUNCTION BUTTONS WITH ROTARY SWITCH SETTING AT 2 (for monoscopic operations).

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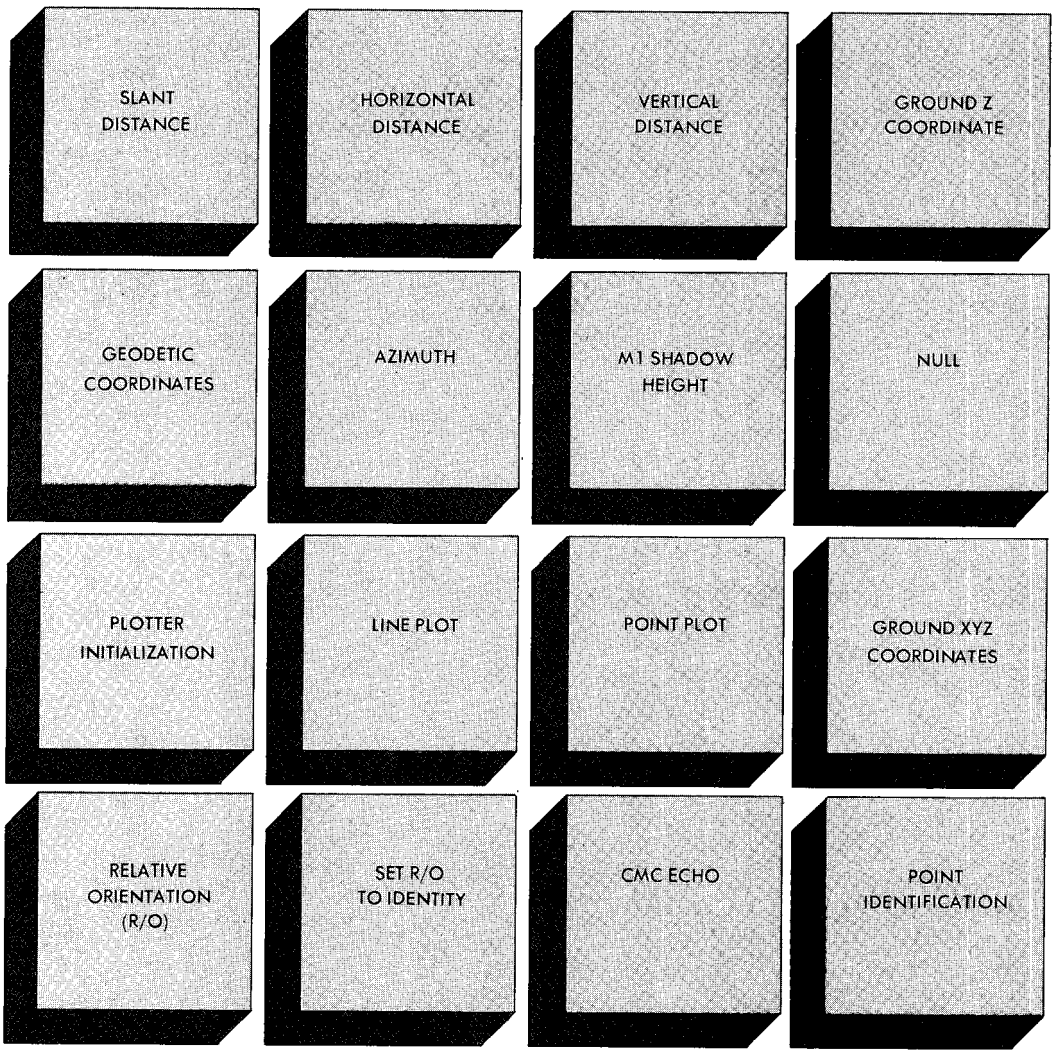

FIGURE 11. OUTPUT FUNCTION BUTTONS WITH ROTARY SWITCH SETTING AT 1 (for stereoscopic operations).

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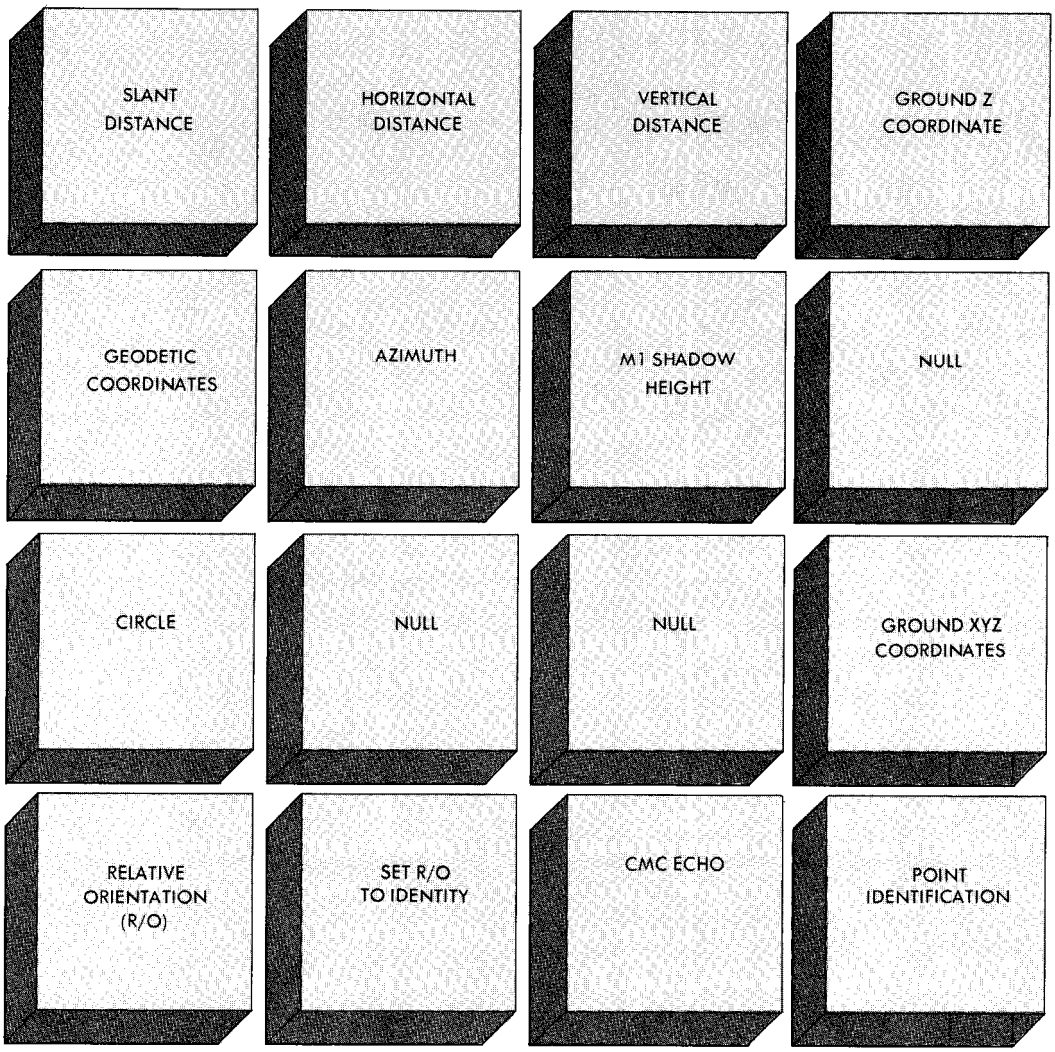

FIGURE 12. OUTPUT FUNCTION BUTTONS WITH ROTARY SWITCH SETTING AT 3 (for stereoscopic operations).

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Table 6. Output Function Buttons

Button	Rotary Switch Setting*	Output
DISTANCE	Ø & 2	Distance - between 2 consecutive points at ground level - between series of points at ground level - between 1 initial point & several terminal points, each of which is used to calculate distance from initial point; called spoking
AZIMUTH	Ø,1,2&3	Azimuth - from true North of 2 consecutive points at same elevation; always relative to first 2 points transmitted - from center point to several other points N.B. Any azimuth calculated between 2 points less than 2 ft. apart will have a very questionable accuracy due to pointing errors
AREA	Ø & 2	Area of a polygon
GEODETIC COORDINATES	Ø,1,2&3	Geodetic position of point transmitted

* Rotary switch settings Ø and 2 are for monoscopic operations; settings 1 and 3 are for stereoscopic operations.

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Table 6. Output Function Buttons (continued)

Button	Rotary Switch Setting	Output
RELIEF HEIGHT	Ø & 2	Relief height of vertical objects only; e.g., poles, walls, bldgs., or holes
M1 SHADOW HEIGHT	Ø,1,2&3	M1 shadow height; vertical objects; uses solar elevation, position of tip of shadow, & position of base of shadow to calculate height; for best results, shadow should lie on level ground
M2 SHADOW HEIGHT	Ø & 2	M2 shadow height of objects; also called Q factor shadow height; uses sun angle, solar azimuth, position of tip of object's shadow & position of top of object to calculate vertical distance
Q-AZIMUTH	Ø & 2	Q-azimuth of object; the azimuth between end of shadow cast by object and projected ground point defined by a line from camera station through top of object
PLOTTER INITIALIZATION	Ø & 1	Used to coordinate frame of photography & plotter; sets plotter origin & determines scale of plot
LINE PLOT	Ø & 1	Plotted lines; determined by type of point transmitted
		- initial — pen head moves; no line drawn; used to move from one set of plotted lines to another

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Table 6. Output Function Buttons (continued)

Button	Rotary Switch Setting	Output
LINE PLOT (continued)		- intermediate pen head moves; line is drawn - terminal pen head moves; line is drawn Spoking: a sequence with an initial point & several terminal points will cause spoking; line drawn from initial point to each terminal point Closing a polygon: a terminal point preceded by several intermediate points & an initial point; when terminal point is transmitted, line is drawn from last intermediate to terminal & then from terminal to initial point
POINT PLOT	Ø & 1	Plot of points; plotter will "dot" desired points; "dot" is very small < with vertex at transmitted point's position; after each terminal point is plotted, pen head returns to initial point of sequence
RELIEF PLOT	Ø	Line plot of object with corrections made for relief displacement
NORTH ARROW	Ø	True-north arrow drawn on completed plot

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Table 6. Output Function Buttons (continued)

Button	Rotary Switch Setting	Output
GROUND XYZ COORDINATES	Ø,1,2&3	Local vertical coordinates of point transmitted; this coordinate system has z axis positive up along geodetic normal, y axis in direction of ground track velocity vector & x axis to form a right-handed system; origin of system is at lens node of camera at time of - reference scan for panoramic photography [redacted] 25X1 - on stereo mensuration all points will be relative to the first data point transmitted
CMC ECHO	Ø,1,2&3	Comparator coordinates in microns & counts; same count as x & y coordinates in windows on comparator
POINT IDENTIFICATION	Ø,1,2&3	Identification of 2 points used for concurrent calculations; rotary switches must be advanced for each point transmitted
CIRCLE	2 & 3	The best fitting diameter for the circle pointed; also the maximum and minimum diameter for the points transmitted

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Table 6. Output Function Buttons (continued)

Button	Rotary Switch Setting	Output
CYLINDER	2	Diameter of the cylinder pointed, distance between the 2 parallel lines (or "edges of cylinder") pointed, the maximum residuals of the 2 parallel lines, and the azimuth of the 2 parallel lines N.B. This function is not accurate for inclined cylinders
CYLINDER SHADOW	2	Diameter of the cylinder pointed, distance between the 2 parallel lines (or "edges of cylinder's shadow") pointed, the maximum residuals of the 2 parallel lines, & the azimuth of the 2 parallel lines
SLANT DISTANCE	1 & 3	Slant Distance - between 2 consecutive points at ground level - between series of points at at ground level - between 1 initial point & several terminal points, each of which is used to calculate distance from initial point; called spoking
HORIZONTAL DISTANCE	1 & 3	Horizontal Distance - between 2 consecutive points at ground level

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Table 6. Output Function Buttons (continued)

Button	Rotary Switch Setting	Output
HORIZONTAL DISTANCE (continued)		- between series of points at ground level - between 1 initial point & several terminal points, each of which is used to calculate distance from initial point; called spoking
VERTICAL DISTANCE	1 & 3	Vertical Distance - between 2 consecutive points at ground level - between series of points at at ground level - between 1 initial point & several terminal points, each of which is used to calculate distance from initial point; called spoking
GROUND Z COORDINATE	1 & 3	The Z coordinate of the ground coordinates
RELATIVE ORIENTATION (R/O)	1 & 3	Relative orientation of stereoscopic pairs of photography with respect to each other; an additional pitch, roll & yaw
SET R/O TO IDENTITY	1 & 3	Nullifies relative orientation; sets matrix to identity

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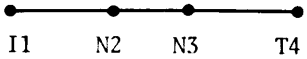
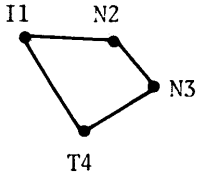
Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output*

Calculation†	Procedures	Mensural Output
Distance: between 2 consecutive points at ground level	Turn first rotary switch to desired setting	------
	Press DISTANCE button & transmit point 1 as initial point	------
	Transmit point 2 as terminal point	Distance between points 1 & 2
Distance: between series of points at ground level  or 	Turn first rotary switch to desired setting	------
	Press DISTANCE button & transmit point 1 as initial point	------
	Transmit point 2 as intermediate point	Distance between points 1 & 2
	Transmit point 3 as intermediate point	Distance between points 2 & 3
	Transmit point 4 as terminal point	Distance between points 3 & 4; distance between points 4 & 1

* In the illustrations the points are numbered in the order in which they may be transmitted. Designators for the points are: I = initial, N = intermediate or normal, & T = terminal.

† The calculations in column one are samples.

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

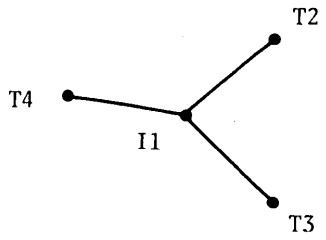
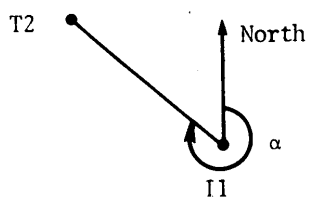
Calculation	Procedures	Mensural Output
Distance: spoking; between 1 initial point & several terminal points; each terminal point used to calculate distance from initial point	Turn first rotary switch to desired setting	------
	Press DISTANCE button & transmit point 1 as initial point	------
	Transmit point 2 as terminal point	Distance between points 1 & 2
	Transmit point 3 as terminal point	Distance between points 1 & 3
	Transmit point 4 as terminal point	Distance between points 1 & 4
Azimuth: from true north of line between 2 consecutive points referenced at initial point; α = azimuth	Turn first rotary switch to desired setting	------
	Press AZIMUTH button & transmit point 1 as initial point	------
	Transmit point 2 as terminal point	Azimuth of points 1 & 2

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

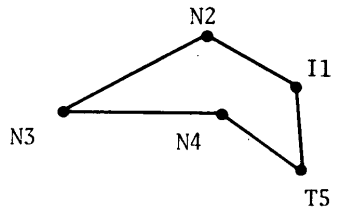
Calculation	Procedures	Mensural Output
Azimuth: of series of lines	Turn first rotary switch to desired setting	------
	Press AZIMUTH button & transmit point 1 as initial point	------
	Transmit point 2 as intermediate point	Azimuth of line between points 1 & 2
	Transmit point 3 as intermediate point	Azimuth of line between points 2 & 3
	Transmit point 4 as intermediate point	Azimuth of line between points 3 & 4
	Transmit point 5 as terminal point	Azimuth of line between points 4 & 5; azimuth of line between points 5 & 1

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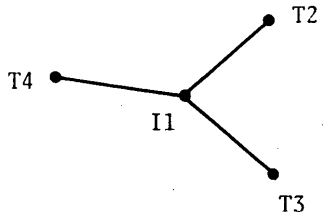
Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Azimuth: spoking from center point to several other points	Turn first rotary switch to desired setting	------
	Press AZIMUTH button & transmit point 1 as initial point	------
	Transmit point 2 as terminal point	Azimuth of line between points 1 & 2
	Transmit point 3 as terminal point	Azimuth of line between points 1 & 3
	Transmit point 4 as terminal point	Azimuth of line between points 1 & 4
Area: of polygon	Turn first rotary switch to desired setting	------
	Press AREA button & transmit point 1 as initial point	------
	Proceeding clockwise or counter clockwise, transmit all points as intermediate points except point 8	------
	Transmit point 8 as terminal point	Area of a polygon



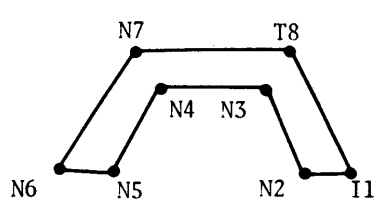


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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Geodetic Coordinates: of single point	Turn first rotary switch to desired setting	------
	Press GEODETIC COORDINATES button & transmit point	Latitude & longitude of point transmitted
Relief Height: vertical objects only; e.g. poles, walls, buildings, holes	Turn first rotary switch to desired setting	------
	Press RELIEF HEIGHT button & transmit point 1 as initial point; must represent bottom of structure or point nearest earth's surface	------
	Transmit point 2 as terminal point; must represent opposite end of structure, directly above or below point 1	Relief height of structure

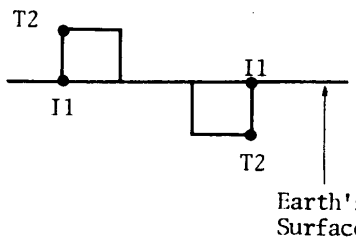

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
M1 Shadow Height: shadow should be on level ground; shadows not on level ground will be projected to the horizontal at base of object; height of vertical objects only; solar elevation, position of tip of shadow, & position of base of shadow used to calculate height	Turn first rotary switch to desired setting	------
	Press M1 SHADOW HEIGHT button & transmit point 1 as initial point; must represent tip of object's shadow	------
	Transmit point 2 as terminal point; must be at base of shadow on a line parallel to edge of shadow transmitted as point 1	M1 shadow height of vertical object

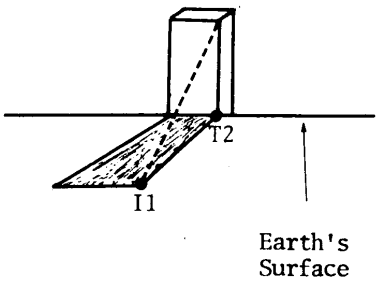

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
M2 Shadow Height: Q-factor shadow height; vertical distances only; uses sun angle, solar azimuth, position of tip of object's shadow, & position of top of object to calculate height	Turn first rotary switch to desired setting	------
	Press M2 SHADOW HEIGHT button & transmit point 1 as initial point; must represent tip of vertical object's shadow	------
	Transmit point 2 as terminal point; must represent top of object corresponding to point on shadow sent as point 1	M2 shadow height of vertical object

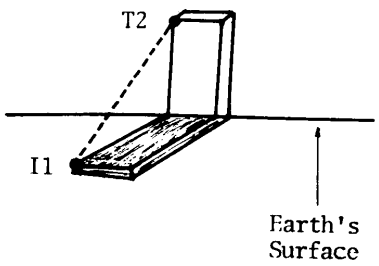

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Q-Azimuth: theoretical azimuth from end of shadow cast by vertical object to projected ground point defined by a line from camera station through top of object	Turn first rotary switch to desired setting	------
	Press Q-AZIMUTH button & transmit point A as initial point	Theoretical azimuth of line segment AB

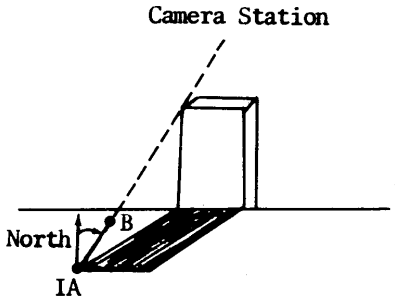

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Relief Plot: for bldg with considerable relief displacement, e.g., roof to be shifted over base of bldg	Turn first rotary switch to desired setting	------
	Press LINE PLOT button & drive pen head to base of object by transmitting base as initial point	------
	Release LINE PLOT button & press RELIEF PLOT button	------
	Transmit as intermediate point top of object that corresponds to initial point transmitted for base	------
	After RELIEF PLOT READY message is printed on teletype, transmit all other points for which relief displacement correction is necessary	Line plot with relief displacement correction made
	To do relief plotting with a different height or to use other plotting functions, release RELIEF PLOT button & press LINE PLOT or POINT PLOT button & continue plotting	

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
North Arrow: on completed plot	Turn first rotary switch to desired setting	------
	With plotter drives, move pen head to unmarked area; press NORTH ARROW button & transmit any point as initial point	North arrow
Ground XYZ Coordinates: of single point	Turn first rotary switch to desired setting	------
	Press GROUND XYZ button & transmit point	Coordinates of point in local coordinate system
CMC Echo: of single point	Turn first rotary switch to desired setting	------
	Press CMC ECHO button & transmit point	CMC coordinates of point transmitted
Point Identification: of 2 points in sequence of points	Turn first rotary switch to desired setting	------
	Press POINT IDENTIFICATION button; set rotary switches on electronic module to desired values; transmit sequence of points	Identification of 2 points of a sequence used for concurrent calculations

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

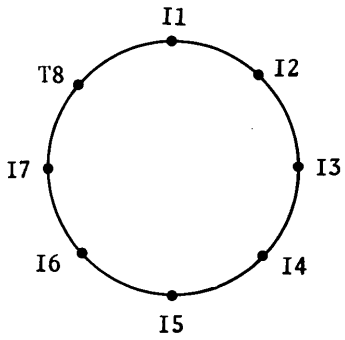
Calculation	Procedures	Mensural Output
Circle: diameter of circle at ground level; must transmit at least 3 & no more than 20 points	Turn first rotary switch to desired setting	------
	Press CIRCLE button & transmit point 1 as initial point	------
	Transmit all other points on circle as initial points until you reach the last point; if a point is transmitted in error, delete it by transmitting a normal point	------
	Transmit the last point as a terminal point	The best fitting diameter of the circle; & the maximum & minimum diameters of the points transmitted

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

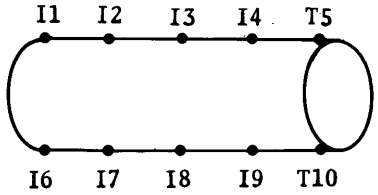
Calculation	Procedures	Mensural Output
Cylinder: diameter of cylinder when the edges are identified; an equal number of points must be transmitted for each edge; no more than 14 points per edge can be transmitted	Turn the first rotary switch to desired setting	------
	Press CYLINDER button & transmit points 1-4 as initial points; if a point is transmitted in error, delete it by transmitting a normal point	------
	Transmit point 5 as terminal point	------
	Transmit points 6-9 on the other edge as initial points; if a point is transmitted in error, delete it by transmitting a normal point	------
	Transmit point 10 as a terminal point	Diameter of the cylinder; distance between the 2 parallel lines (or edges) of the cylinder; the maximum residuals & the azimuth of the 2 parallel lines

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

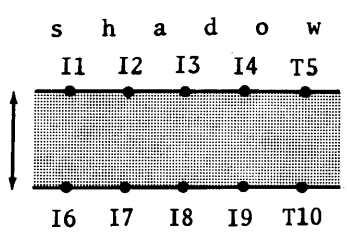
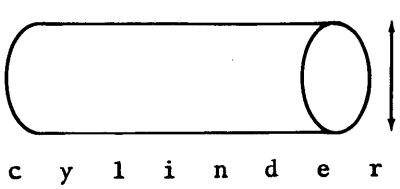
Calculation	Procedures	Mensural Output
Cylinder Shadow: diameter of cylinder when edges of its shadow are identified; an equal number of points must be transmitted for each edge; no more than 14 points per edge can be transmitted	Turn first rotary switch to desired setting	------
	Press CYLINDER SHADOW button & transmit points 1-4 as initial points; if a point is transmitted in error, delete it by transmitting a normal point	------
	Transmit point 5 as a terminal point	------
	Transmit points 6-9 on the other edge of the shadow as initial points; if a point is transmitted in error, delete it by transmitting a normal point	------
	Transmit point 10 as a terminal point	Diameter of the cylinder; distance between the 2 parallel lines (or edges) of the cylinder's shadow; the maximum residuals & the azimuth of the 2 parallel lines

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Slant Distance: between 2 consecutive points at ground level	Turn first rotary switch to desired setting	------
	Press SLANT DISTANCE button	------
	See "Distance: between 2 consecutive points...." for remaining procedures	Slant distance of points transmitted; see "Distance: between 2 consecutive points...."
Slant Distance: between series of points at ground level	Turn first rotary switch to desired setting	------
	Press SLANT DISTANCE button	------
	See "Distance: between series of points...." for remaining procedures	Slant distance of points transmitted; see "Distance: between series of points....."
Slant Distance: spoking; between 1 initial point & several terminal points; each terminal point used to calculate distance from initial point	Turn first rotary switch to desired setting	------
	Press SLANT DISTANCE button	------
	See "Distance: spoking....." for remaining procedures	Slant distance of points transmitted; see "Distance: spoking....."

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Horizontal Distance: between 2 consecutive points at ground level	Turn first rotary switch to desired setting	------
	Press HORIZONTAL DISTANCE button	------
	See "Distance: between 2 consecutive points...." for remaining procedures	Horizontal distance of points transmitted; see "Distance: between 2 consecutive points...."
Horizontal Distance: between series of points at ground level	Turn first rotary switch to desired setting	------
	Press HORIZONTAL DISTANCE button	------
	See "Distance: between series of points....." for remaining procedures	Horizontal distance of points transmitted; see "Distance: between series of points....."

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Horizontal Distance: spoking; between 1 initial point & several terminal points; each terminal point used to calculate distance from initial point	Turn first rotary switch to desired setting	------
	Press HORIZONTAL DISTANCE button	------
	See "Distance: spoking...." for remaining procedures	Horizontal distance of points transmitted; see "Distance: spoking...."
Vertical Distance: between 2 consecutive points at ground level	Turn first rotary switch to desired setting	------
	Press VERTICAL DISTANCE button	------
	See "Distance: between 2 consecutive points...." for remaining procedures	Vertical distance of points transmitted; see "Distance: between 2 consecutive points...."

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Vertical Distance: between series of points at ground level	Turn first rotary switch to desired setting	------
	Press VERTICAL DISTANCE button	------
	See "Distance: between series of points...." for remaining procedures	Vertical distance of points transmitted; see "Distance: between series of points...."
Vertical Distance: spoking; between 1 initial point & several terminal points; each terminal point used to calculate distance from initial point	Turn first rotary switch to desired setting	------
	Press VERTICAL DISTANCE button	------
	See "Distance: spoking...." for remaining procedures	Vertical distance of points transmitted; see "Distance: spoking...."

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Table 7. Using Transmission and Output Function Buttons to Obtain Mensural Output (continued)

Calculation	Procedures	Mensural Output
Ground Z Coordinate: of a single point	Turn first rotary switch to desired setting	------
	Press GROUND Z COORDINATE button & transmit point as an initial point	The Z coordinate of the ground coordinates of the point transmitted
Relative Orientation: of stereoscopic pairs of photography with respect to each other; must transmit at least 6 and no more than 20 points which must be as close as possible to the same ground elevation	Turn first rotary switch to desired setting	------
	Press R/O button & transmit first point as initial point	------
	Transmit all other points except the last one as initial points; if a point is transmitted in error, delete it by transmitting a normal point	------
	Transmit the last point as a terminal point	An additional pitch, roll, & yaw

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X1 [redacted] PLOTTER

X1 A [redacted] plotter (Figure 13) is used with the Real-Time Mensuration Program to obtain a plot of objects discernible on film according to a specified scale and size. It can produce a plot up to 29.5 inches wide.

TURN-ON PROCEDURES

X1 Turning a [redacted] plotter on involves these steps in the order listed.

1. Move the POWER dial to the ON position.
2. Move the CHART DRIVE dial to the ON position.
3. Move the PEN dial to the UP position and then release it.
4. Using the CARRIAGE FAST RUN dial, drive the pen head to the center of the drum.
5. Using the DRUM FAST RUN dial, supply the plotter with adequate paper.

INITIALIZING A PLOTTER

Before a plotter can be used with the RTMP, the photo-plot environment must be established, i.e., initialization must take place. To
X1 initialize a [redacted] plotter, press the PLOTTER INITIALIZATION button and then follow these procedures in the order listed.

1. Draw the longest line segment that can be drawn through the area to be plotted.
2. Transmit the approximate center of the area to be plotted as an initial point. You will receive this

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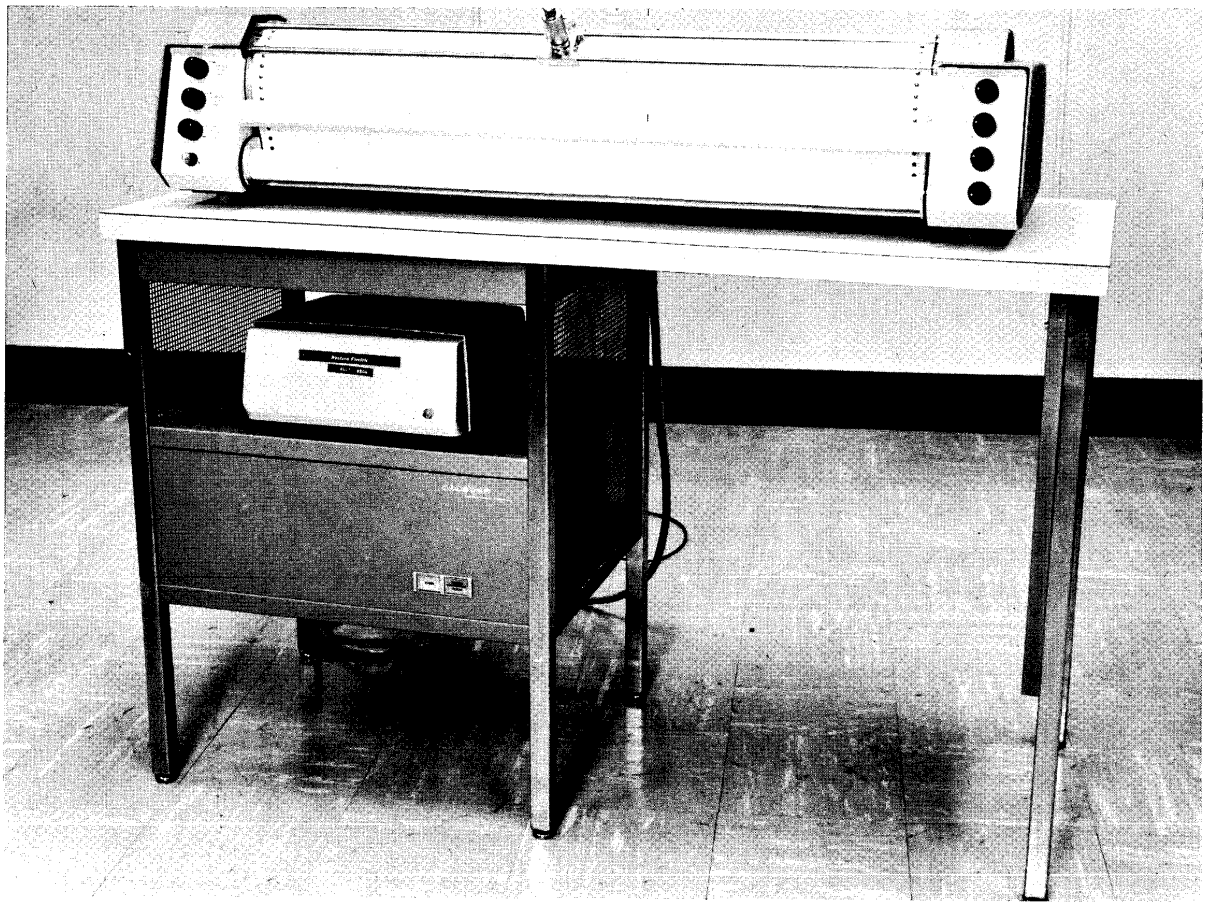

FIGURE 13. [redacted] PLOTTER.

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message via the teletype you are using:

ORIGIN SET--SEND FIRST IMAGE LIMIT

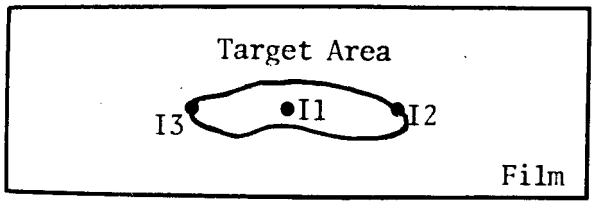
3. Transmit one end point of the line drawn as an initial point. You will receive this message:

SEND LAST IMAGE LIMIT

4. Transmit the other end point of the line as an initial point. You will receive this message:

PLOTTER INITIALIZED
SCALE = 1:XXXX

The scale is the scale of the rectified plot to be drawn. It is the ratio between the parameter entered for plot distance and the distance between the image limits on the plotter.



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CHAPTER III. PROCESSING PHOTOGRAPHY FROM THE KH-4A AND KH-4B CAMERA SYSTEMS

Using the Real-Time Mensuration Program to process photography derived from the KH-4A and KH-4B camera systems involves these steps in the order listed:

STEP 1 obtaining parameters

STEP 2 choosing ellipsoids

STEP 3 marking fiducials (or measuring grid coordinates)

STEP 4 initializing a teletype

STEP 5 submitting parameters

STEP 6 initializing a comparator

STEP 7 transmitting points for calculations

STEP 8 terminating frame operations

There are several options under which KH-4 photography may be processed. The options available are these:

Monoscopic Options

K4A frame of photography; KH-4A camera system

K4B frame of photography; KH-4B camera system

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K4BR frame of photography; KH-4B camera system; MPF retrieval

C4A chip of photography; KH-4A camera system

C4B chip of photography; KH-4B camera system

C4BR chip of photography; KH-4B camera system; MPF retrieval

Stereoscopic Options

SK4A two frames of stereo photography; KH-4A camera system

SK4B two frames of stereo photography; KH-4B camera system

SK4BR two frames of stereo photography; KH-4B camera system; MPF retrieval

SC4A two chips of stereo photography; KH-4A camera system

SC4B two chips of stereo photography; KH-4B camera system

SC4BR two chips of stereo photography; KH-4B camera system; MPF retrieval

When using any of the stereoscopic options, two additional steps are available. They are:

* transmitting relative orientation (R/O) points to calculate the relative orientation of the two frames or chips of photography

* switching to the corresponding monoscopic option for either the left or right stage

Both of these steps are optional.

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K4A OPTION

OBTAINING PARAMETERS

You will be responsible for obtaining all parameters needed for each use of the program. Parameters will identify the film being processed, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional.

Before using the program, assemble all required parameters. These parameters and their sources are listed in Table 8. Most parameters appear in the Best-Fit Ephemeris for the mission from which the film is derived.

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Table 8. Parameters Needed for K4A Option

Parameter	Source
System name; K4A	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must determine
Mission number	Film
Pass number	Film
Frame number	Film
Camera A or F; A for aft looking camera; F for forward looking camera	Film
Focal length; millimeters	Best-Fit Ephemeris
Vehicle pitch; degrees	Best-Fit Ephemeris
Vehicle roll; degrees	Best-Fit Ephemeris
Vehicle yaw; degrees	Best-Fit Ephemeris
Nadir latitude; degrees, minutes, & direction	Best-Fit Ephemeris
Nadir longitude; degrees, minutes, & direction	Best-Fit Ephemeris
Center of format latitude; degrees, minutes, & direction	Best-Fit Ephemeris
Center of format longitude; degrees, minutes, & direction	Best-Fit Ephemeris
Inertial velocity; feet per second	Orbital Mission Listing for the mission from which the film was derived for all missions prior to

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Table 8. Parameters Needed for K4A Option (Continued)

Inertial velocity; feet per second (continued)	[redacted] if the Orbital Mission Listing is not available, use the ground track velocity in place of the inertial velocity & the program will make the necessary changes needed for correct calculations; for mission [redacted] & all subsequent missions see the Best-Fit Ephemeris
Ground track velocity; feet per second	Best-Fit Ephemeris
Inertial azimuth; degrees & minutes	Orbital Mission Listing for the mission from which the film was derived for all missions prior to [redacted] if the Orbital Mission Listing is not available, use the ground track azimuth in place of the inertial azimuth & the program will make the necessary changes needed for correct calculations; for mission [redacted] & all subsequent missions see the Best-Fit Ephemeris
Ground track azimuth; degrees & minutes	Best-Fit Ephemeris
Sun elevation; degrees & minutes	Best-Fit Ephemeris
Sun azimuth; degrees & minutes	Best-Fit Ephemeris
Altitude; feet	Best-Fit Ephemeris
Scan rate; radians per second	Best-Fit Ephemeris
Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis---	6378177.8 m.
		Semi-minor axis---	6356796.05 m.
		E^2 ---	.006693422
Krassovsky	KVY	Semi-major axis---	6378245.0 m.
		Semi-minor axis---	6356863.0188 m.
		E^2 ---	.006693422
International	INT	Semi-major axis---	6378388.0 m.
		Semi-minor axis---	6356911.9961 m.
		E^2 ---	.006722670
Clarke 1866	CRK	Semi-major axis---	6378206.4 m.
		Semi-minor axis---	6356583.8 m.
		E^2 ---	.006768658
Bessel	BSL	Semi-major axis---	6377397.155 m.
		Semi-minor axis---	6356078.9628 m.
		E^2 ---	.006674372
Army Map Service	AMS	Semi-major axis---	6378270.0 m.
		Semi-minor axis---	6356794.3434 m.
		E^2 ---	.006722670

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MARKING
FIDUCIALS

Mount the film positive, emulsion side up, on a light table. There will be a small triangular jutting located between the date and the classification on the frame. Fiducial 1 will be the midpoint of the base of the triangle. Mark this point so that you can locate it again later. Fiducial 2 will be an arbitrary point along the format edge in the direction that the titling reads. See Figure 14, which appears at the end of this chapter.

INITIALIZING
A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed and the camera system that produced the photography. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)
Type	INIT
Press	RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

Next,

Type	K4A
Press	RETURN key

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You will then receive this message:

LOAD FILM

Load the film positive on the comparator. Procedures for mounting film on a comparator will depend on which comparator you use. These procedures can be found in CHAPTER II, THE EQUIPMENT.

SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message:

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 111050

Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

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Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the correct character. The incorrect character will remain on the printed page. For example:

ENTER SYSTEM NAME K4C↑A

You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

ENTER SYSTEM NAME		K4A	
LOAD FILM			
PROJECT NUMBER	XXXXXX	111052	
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	111050	RETURN key
EMULSION	ZZ		

You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters.

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For example,

ENTER SYSTEM NAME		K4A	
LOAD FILM			
PROJECT NUMBER	XXXXXX	111052	
EMULSION	ZZ	UP	
MISSION	XXXX-X	DELET	RETURN key
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	111050	RETURN key
EMULSION	ZZ		

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

Correcting an Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simply type TERM and then press the RETURN key. The teletype will print TERM.

INITIALIZING A COMPARATOR

After you have submitted all parameters, this message will appear on the teletype you are using:

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INITIALIZE VIEWER--SEND FIRST FIDUCIAL

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit fiducials to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the comparator crosshairs over fiducial 1. Transmit fiducial 1 to the program by pressing the FIDUCIAL button. You will then receive the coordinates of fiducial 1 via the teletype. You will also receive this message:

SEND NEXT FIDUCIAL

Move the crosshairs about two to four inches to the right along the format edge. This point is fiducial 2. Transmit fiducial 2 by pressing the FIDUCIAL button. You will receive the coordinates of fiducial 2 on the teletype. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

TRANSMITTING POINTS
FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.

2. Release any output function buttons that may have been pressed.

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3. Press the appropriate output function buttons for the calculations you want.

4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

TERMINATING FRAME OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over fiducial 1. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

FRAME OPERATIONS TERMINATED DATE TIME
POINTING COUNT = XX FILM DRIFT = XX.XX MICRONS

The pointing count is the total number of points transmitted including fiducials. Film drift is the distance the film has moved at fiducial 1 from the time fiducials 1 and 2 were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

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SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		K4A
LOAD FILM		
PROJECT NUMBER	XXXXXX	111050
EMULSION	ZZ	UP
MISSION	XXXX-X	
PASS	XXXZ	111D
FRAME	XXX	111
CAMERA A OR F	Z	F
FOCAL LENGTH	XXX.XXX	111.111
VEH PITCH	SXX.XXXX	+11.1111
VEH ROLL	SXX.XXXX	-11.1111
VEH YAW	SXX.XXXX	+11.1111
NADIR LAT	XX-XX.XXZ	22-22.22N
NADIR LONG	XXX-XX.XXZ	111-11.11W
CTR FORMAT LAT	XX-XX.XXZ	11-11.11N
CTR FORMAT LONG	XXX-XX.XXZ	111-11.11W
IN VELOCITY	XXXXX	25742
GT VELOCITY	XXXXX	11111
IN AZIMUTH	XXX-XX	190-56
GT AZIMUTH	XXX-XX	111-11
EL-SUN	XX-XX	11-11
SUN-AZ	XXX-XX	111-11
ALTITUDE	XXXXXXX	1111111
SCAN RATE	X.XXX	1.111
ELEVATION	SXXXXX	+01111
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	09.0

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

X FID=- 0
Y FID=- 0

SEND NEXT FID

X FID=+ 90000
Y FID=+ 0

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

VIEWER INITIALIZED

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[redacted]

[redacted]

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LAT= 24D 29M 39.4S N
LONG= 110D 57M 28.8S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1332+

POINTING COUNT= 5 FILM DRIFT= 5.00 MICRONS

[redacted]

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K4B OPTION

OBTAINING
PARAMETERS

You will be responsible for obtaining all parameters needed for each use of the program. Parameters will identify the film being processed, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional.

Before using the program, assemble all required parameters. These parameters and their sources are listed in Table 9. Most parameters appear on the MPF listing for the mission and bucket from which the photography was derived.

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Table 9. Parameters Needed for K4B Option

Parameter	Source
System name; K4B	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must determine
Mission number	Film
Pass number	Film
Frame number	Film
Camera A or F; A for aft looking camera; F for forward looking camera	Film
Focal length; millimeters	MPF listing
Vehicle pitch; degrees	MPF listing
Vehicle roll; degrees	MPF listing
Vehicle yaw; degrees	MPF listing
Nadir latitude; degrees, minutes, & direction	MPF listing
Nadir longitude; degrees, minutes, & direction	MPF listing
Center of format latitude; degrees minutes, & direction	MPF listing
Center of format longitude; degrees minutes, & direction	MPF listing
Inertial velocity; feet per second	Orbital Mission Listing for the mission from which the film was derived for all missions prior to [redacted] if the Orbital Mission Listing

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Table 9. Parameters Needed for K4B Option (Continued)

Inertial velocity; feet per second (continued)	is not available, use the ground track velocity in place of the inertial velocity & the program will make the necessary changes needed for correct calculations; for mission [redacted] & all subsequent missions see the MPF listing
Ground track velocity; feet per second	MPF listing
Inertial azimuth; degrees & minutes	Orbital Mission Listing for the mission from which the film was derived for all missions prior to [redacted] if the Orbital Mission Listing is not available, use the ground track azimuth in place of the inertial azimuth & the program will make the necessary changes needed for correct calculations; for mission [redacted] & all subsequent missions see the MPF listing
Ground track azimuth; degrees & minutes	MPF listing
Sun elevation; degrees & minutes	MPF listing
Sun azimuth; degrees & minutes	MPF listing
Altitude; feet	MPF listing
Scan rate; radians per second	MPF listing
Translation; microns	MPF listing
Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis---	6378177.8 m.
		Semi-minor axis---	6356796.05 m.
		E^2 ---	.006693422
Krassovsky	KVY	Semi-major axis---	6378245.0 m.
		Semi-minor axis---	6356863.0188 m.
		E^2 ---	.006693422
International	INT	Semi-major axis---	6378388.0 m.
		Semi-minor axis---	6356911.9961 m.
		E^2 ---	.006722670
Clarke 1866	CRK	Semi-major axis---	6378206.4 m.
		Semi-minor axis---	6356583.8 m.
		E^2 ---	.006768658
Bessel	BSL	Semi-major axis---	6377397.155 m.
		Semi-minor axis---	6356078.9628 m.
		E^2 ---	.006674372
Army Map Service	AMS	Semi-major axis---	6378270.0 m.
		Semi-minor axis---	6356794.3434 m.
		E^2 ---	.006722670

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MARKING
FIDUCIALS

Mount the film positive, emulsion side up, on a light table. Note the series of small white spots (rail holes) along the top of the frame. There will be two irregularities to this series of rail holes:

* binary block
  a small group of dots, some slightly raised from the rail holes line; indicates vehicle clock time

* center of format
  a pair of rail holes directly over the frame center

The Panoramic Geometry Stripe (PG Stripe) is a narrow white line on the frame's border about 0.01 inches from the format edge. Extend a line joining the two rail holes which are over the center of format until it intersects the inside edge of the PG Stripe. This intersection will be fiducial 1. With a pinpoint or by some other method, mark fiducial 1 so that it can be located again later. Fiducial 2 will be on the PG Stripe toward the titling of the frame. See Figure 15, which appears at the end of this chapter.

INITIALIZING
A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed and the camera system that produced that photography. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)

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Type INIT

Press RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

Next,

Type K4B

Press RETURN key

You will then receive this message:

LOAD FILM

Load the film positive on a comparator. Procedures for mounting film on a comparator will depend on which comparator you use. These procedures can be found in CHAPTER II, THE EQUIPMENT.

SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

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As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 111105

Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the correct character. The incorrect character will remain on the printed page. For example:

ENTER SYSTEM NAME K4C↑B

You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

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Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

```
ENTER SYSTEM NAME              K4B
LOAD FILM
PROJECT NUMBER       XXXXXX    111052
EMULSION             ZZ        DELET      RETURN key
PROJECT NUMBER       XXXXXX    111050     RETURN key
EMULSION             ZZ
```

You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters.

For example,

```
ENTER SYSTEM NAME              K4B
LOAD FILM
PROJECT NUMBER       XXXXXX    111052
EMULSION             ZZ        UP
MISSION              XXXX-X    DELET      RETURN key
EMULSION             ZZ        DELET      RETURN key
PROJECT NUMBER       XXXXXX    111050     RETURN key
EMULSION             ZZ
```

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

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Correcting an Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simple type TERM and then press the RETURN key. The teletype will print TERM.

INITIALIZING A COMPARATOR

After you have submitted all parameters, this message will appear on the teletype you are using:

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit fiducials to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the comparator crosshairs over fiducial 1. Transmit fiducial 1 to the program by pressing the FIDUCIAL button. You will then receive the coordinates of fiducial 1. You will also receive this message:

SEND NEXT FIDUCIAL

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Move the crosshairs about two to four inches to the right along the PG Stripe. This point is fiducial 2. Transmit fiducial 2 by pressing the FIDUCIAL button. You will receive the coordinates of fiducial 2 on the teletype. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

TRANSMITTING POINTS
FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.

2. Release any output function buttons that may have been pressed.

3. Press the appropriate output function buttons for the calculations you want.

4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

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TERMINATING FRAME
OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over fiducial 1. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

FRAME OPERATIONS TERMINATED DATE TIME
POINTING COUNT = XX FILM DRIFT = XX.XX MICRONS

The pointing count is the total number of points transmitted including fiducials. Film drift is the distance the film has moved at fiducial 1 from the time fiducials 1 and 2 were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		K4B
LOAD FILM		
PROJECT NUMBER	XXXXXX	111105
EMULSION	ZZ	UP
MISSION	XXXX-X	
PASS	XXXZ	111A
FRAME	XXX	111
CAMERA A OR F	Z	A
FOCAL LENGTH	XXX.XXX	609.000
VEH PITCH	SXX.XXXX	+09.0000
VEH ROLL	SXX.XXXX	-02.3333
VEH YAW	SXX.XXXX	+00.0900

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NADIR LAT	XX-XX.XXZ	09-09.09N
NADIR LONG	XXX-XX.XXZ	090-00.09W
CTR FORMAT LAT	XX-XX.XXZ	11-11.11N
CTR FORMAT LONG	XXX-XX.XXZ	111-11.11W
IN VELOCITY	XXXXX	25742
GT VELOCITY	XXXXX	25000
IN AZIMUTH	XXX-XX	190-56
GT AZIMUTH	XXX-XX	080-00
EL SUN	XX-XX	08-09
SUN-AZ	XXX-XX	088-00
ALTITUDE	XXXXXXX	0700000
SCAN RATE	X.XXX	4.400
TRANSLATION	XXXXX	30000
ELEVATION	SXXXXX	+09090
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	20.0

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

X FID=+ 109
Y FID=+ 2000

SEND NEXT FID

X FID=+ 1000
Y FID=+ 1000

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

VIEWER INITIALIZED

GROUNDX= 29111.7 FT
GROUNDY= 74890.0 FT
GROUNDZ= -691154.4 FT
LAT= 23D 31M 50.1S S
LONG= 122D 43M 3.3S E

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1559

POINTING COUNT= 5 FILM DRIFT= 6.00 MICRONS

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K4BR OPTION

OBTAINING
PARAMETERS

Except for the parameters available from the MPF, you will be responsible for obtaining the parameters needed for each use of the program. These parameters will identify the film you are processing, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional. Before you use the program, assemble all required parameters. These parameters and their sources are listed in Table 10.

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Table 10. Parameters Needed for K4BR Option

Parameter	Source
System name; K4BR	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must determine
Mission number	Film
Pass number	Film
Frame number	Film
Camera A or F; A for aft looking camera; F for forward looking camera	Film
Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis--- Semi-minor axis--- E^2 ---	6378177.8 m. 6356796.05 m. .006693422
Krassovsky	KVY	Semi-major axis--- Semi-minor axis--- E^2 ---	6378245.0 m. 6356863.0188 m. .006693422
International	INT	Semi-major axis--- Semi-minor axis--- E^2 ---	6378388.0 m. 6356911.9961 m. .006722670
Clarke 1866	CRK	Semi-major axis--- Semi-minor axis--- E^2 ---	6378206.4 m. 6356583.8 m. .006768658
Bessel	BSL	Semi-major axis--- Semi-minor axis--- E^2 ---	6377397.155 m. 6356078.9628 m. .006674372
Army Map Service	AMS	Semi-major axis--- Semi-minor axis--- E^2 ---	6378270.0 m. 6356794.3434 m. .006722670

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MARKING
FIDUCIALS

Mount the film positive, emulsion side up, on a light table. Note the series of small white spots (rail holes) along the top of the frame. There will be two irregularities to this series of rail holes:

* binary block
  a small group of dots, some slightly raised from the rail holes line; indicates vehicle clock time

* center of format
  a pair of rail holes directly over the frame center

The Panoramic Geometry Stripe (PG Stripe) is a narrow white line on the frame's border about 0.01 inches from the format edge. Extend a line joining the two rail holes which are over the center of format until it intersects the inside edge of the PG Stripe. This intersection will be fiducial 1. With the pinpoint or by some other method, mark fiducial 1 so that it can be located again later. Fiducial 2 will be on the PG Stripe toward the titling of the frame. See Figure 15, which appears at the end of this chapter.

INITIALIZING
A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed and the camera system that produced that photography. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)

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Type	INIT
Press	RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

Next,

Type	K4BR
Press	RETURN key

You will then receive this message:

LOAD FILM

Load the film positive on a comparator. Procedures for mounting film on a comparator will depend on which comparator you use. These procedures can be found in CHAPTER II, THE EQUIPMENT.

SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

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As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 111105

Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the correct character. The incorrect character will remain on the printed page. For example:

ENTER SYSTEM NAME K4BT↑R

You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

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Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

ENTER SYSTEM NAME		K4BR	
LOAD FILM			
PROJECT NUMBER	XXXXXX	111052	
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	111050	RETURN key
EMULSION	ZZ		

You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters.

For example,

ENTER SYSTEM NAME		K4BR	
LOAD FILM			
PROJECT NUMBER	XXXXXX	111052	
EMULSION	ZZ	UP	
MISSION	XXXX-X	DELET	RETURN key
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	111050	RETURN key
EMULSION	ZZ		

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

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Correcting an Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simply type TERM and then press the RETURN key. The teletype will print TERM.

INITIALIZING A COMPARATOR

After you have submitted your parameters and the MPF retrieval has been successfully completed, you will receive one of the following two messages:

* READY W S.R.-SEND FIRST FIDUCIAL appears if stellar-derived attitude of pan camera is available, or

* READY W/O S.R.-SEND FIRST FIDUCIAL appears is stellar-derived attitude of pan camera is not available

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

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Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit fiducials to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the comparator crosshairs over fiducial 1. Transmit fiducial 1 to the program by pressing the FIDUCIAL button. You will then receive the coordinates of fiducial 1. You will also receive this message:

SEND NEXT FIDUCIAL

Move the crosshairs about two to four inches to the right along the PG Stripe. This point is fiducial 2. Transmit fiducial 2 by pressing the FIDUCIAL button. You will receive the coordinates of fiducial 2 on the teletype. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype or in the retrieved information. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

TRANSMITTING POINTS
FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.

2. Release any output function buttons that may have been pressed.

3. Press the appropriate output function buttons for the calculations you want.

4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

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Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

TERMINATING FRAME OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over fiducial 1. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

```
FRAME OPERATIONS TERMINATED     DATE     TIME
POINTING COUNT = XX     FILM DRIFT = XX.XX MICRONS
```

The pointing count is the total number of points transmitted including fiducials. Film drift is the distance the film has moved at fiducial 1 from the time fiducials 1 and 2 were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

SAMPLE TELETYPE OUTPUT

```
ENTER SYSTEM NAME              K4BR
LOAD FILM
PROJECT NUMBER  XXXXXX         111105
EMULSION        ZZ             DN
MISSION         XXXX-X         [redacted]
PASS            XXXZ           111A
```


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FRAME	XXX	111
CAMERA A OR F	Z	A
ELEVATION	SXXXXX	+09090
ELLIPSOID	ZZZ	AMS
PLOT DIST	XX.X	20.0

READY W/O S.R.--SEND FIRST FIDUCIAL

X FID=+ 109
Y FID=+ 2000

SEND NEXT FID

X FID=+ 200
Y FID=+ 200000

DOF AZIM= 205.352 DEG
IN AZIM= 202.388DEG

VIEWER INITIALIZED

LAT= 20D 14M 40.3S N
LONG= 110D 11M 35.8S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1559

POINTING COUNT= 5 FILM DRIFT= 210276.50 MICRONS

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25X1

C4A OPTION

OBTAINING
PARAMETERS

You will be responsible for obtaining all parameters needed for each use of the program. Parameters will identify the film being processed, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional.

Before using the program, assemble all required parameters. These parameters and their sources are listed in Table 11. Most parameters appear in the Best-Fit Ephemeris for the mission from which the film is derived.

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Table 11. Parameters Needed for C4A Option

Parameter	Source
System name; C4A	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must determine
Mission number	Film
Pass number	Film
Frame number	Film
Camera A or F; A for aft looking camera; F for forward looking camera	Film
Focal length; millimeters	Best-Fit Ephemeris
Vehicle pitch; degrees	Best-Fit Ephemeris
Vehicle roll; degrees	Best-Fit Ephemeris
Vehicle yaw; degrees	Best-Fit Ephemeris
Nadir latitude; degrees, minutes, & direction	Best-Fit Ephemeris
Nadir longitude; degrees, minutes, & direction	Best-Fit Ephemeris
Center of format latitude; degrees, minutes, & direction	Best-Fit Ephemeris
Center of format longitude; degrees, minutes, & direction	Best-Fit Ephemeris
Inertial velocity; feet per second	Orbital Mission Listing for the mission from which the film was derived for all missions prior to

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Table 11. Parameters Needed for C4A Option (Continued)

Inertial velocity; feet per second (continued)	[redacted] if the Orbital Mission Listing is not available, use the ground track velocity in place of the inertial velocity & the program will make the necessary changes needed for correct calculations; for mission [redacted] & all subsequent missions see the Best-Fit Ephemeris 25X1 25X1
Ground track velocity; feet per second	Best-Fit Ephemeris
Inertial azimuth; degrees & minutes	Orbital Mission Listing for the mission from which the film was derived for all missions prior to [redacted] if the Orbital Mission Listing is not available, use the ground track azimuth in place of the inertial azimuth & the program will make the necessary changes needed for correct calculations; for mission [redacted] & all subsequent missions see the Best-Fit Ephemeris 25X1 25X1
Ground track azimuth; degrees & minutes	Best-Fit Ephemeris
Sun elevation; degrees & minutes	Best-Fit Ephemeris
Sun azimuth; degrees & minutes	Best-Fit Ephemeris
Altitude; feet	Best-Fit Ephemeris
Scan rate; radians per second	Best-Fit Ephemeris
First grid; x & y grid coordinates of first grid endpoint; centimeters	You measure & record
Second grid; x & y coordinates of second grid endpoint; centimeters	You measure & record

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Table 11. Parameters Needed for C4A Option (Continued)

Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis---	6378177.8 m.
		Semi-minor axis---	6356796.05 m.
		E^2 ---	.006693422
Krassovsky	KVY	Semi-major axis---	6378245.0 m.
		Semi-minor axis---	6356863.0188 m.
		E^2 ---	.006693422
International	INT	Semi-major axis---	6378388.0 m.
		Semi-minor axis---	6356911.9961 m.
		E^2 ---	.006722670
Clarke 1866	CRK	Semi-major axis---	6378206.4 m.
		Semi-minor axis---	6356583.8 m.
		E^2 ---	.006768658
Bessel	BSL	Semi-major axis---	6377397.155 m.
		Semi-minor axis---	6356078.9628 m.
		E^2 ---	.006674372
Army Map Service	AMS	Semi-major axis---	6378270.0 m.
		Semi-minor axis---	6356794.3434 m.
		E^2 ---	.006722670

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MEASURING GRID COORDINATES

Mount the film positive, emulsion side up, on a light table. There will be a small triangular jutting located between the date and the classification on the frame; this is the center fiducial. To measure the grid coordinates, place a Universal Grid Number 2 over or under the frame so that the grid numbers read correctly. Position the grid so that

* the triangle above the X = 46 line covers the center fiducial, and
* the small dash lines at Y = 14.8 are along the top format edge of the frame

These two conditions should be met as closely as possible. However, because of film deformation, absolute congruency is not always feasible. With a pinpoint or by some other method, mark the end points of the longest line segment (usually diagonal) that can be drawn through the target area. These points must fall on grid intersections. Record the grid coordinates of each of the two end points and note the order in which you recorded them. Cut the chip from the frame.

INITIALIZING A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed and the camera system that produced the photography. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)
Type	INIT
Press	RETURN key

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You will then receive this message on the teletype:

ENTER SYSTEM NAME

Next,

Type C4A

Press RETURN key

You will then receive this message:

LOAD CHIP

Load the film positive on the comparator. Procedures for placing the chips can be found in CHAPTER II, THE EQUIPMENT.

SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message

PROJECT NUMBER XXXXXX

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complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 111050

Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the correct character. The incorrect character will remain on the printed page. For example:

ENTER SYSTEM NAME C4C↑A

You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simple type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

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```
ENTER SYSTEM NAME                C4A
LOAD FILM
PROJECT NUMBER        XXXXXX     111052
EMULSION              ZZ         DELET          RETURN key
PROJECT NUMBER        XXXXXX     111050         RETURN key
EMULSION              ZZ
```

You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters.

For example,

```
ENTER SYSTEM NAME                C4A
LOAD FILM
PROJECT NUMBER        XXXXXX     111052
EMULSION              ZZ         UP
MISSION               XXXX-X     DELET          RETURN key
EMULSION              ZZ         DELET          RETURN key
PROJECT NUMBER        XXXXXX     111050         RETURN key
EMULSION              ZZ
```

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

Correcting an Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

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Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simply type TERM and then press the RETURN key. The teletype will print TERM.

INITIALIZING A COMPARATOR

After you have submitted all parameters, this message will appear on the teletype you are using:

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit the grid points to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the comparator crosshairs over the point entered as the first grid. Transmit this point to the program by pressing the FIDUCIAL button. You will then receive the coordinates of this grid point on the teletype. You will also receive this message:

SEND NEXT FIDUCIAL

Position the crosshairs over the point entered as the second grid. Transmit this point to the program by pressing the FIDUCIAL button. You will receive the coordinates of this grid point. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was

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input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

TRANSMITTING POINTS
FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.

2. Release any output function buttons that may have been pressed.

3. Press the appropriate output function buttons for the calculations you want.

4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

TERMINATING FRAME
OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place

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the comparator crosshairs over the first grid point. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

FRAME OPERATIONS TERMINATED DATE TIME
POINTING COUNT = XX FILM DRIFT = XX.XX MICRONS

The pointing count is the total number of points transmitted including grid points. Film drift is the distance the film has moved at the first grid point from the time the grid points were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		C4A
LOAD CHIP		
PROJECT NUMBER	XXXXXX	111050
EMULSION	ZZ	UP
MISSION	XXXX-X	
PASS	XXXZ	011D
FRAME	XXX	021
CAMERA A OR F	Z	A
FOCAL LENGTH	XXX.XXX	600.000
VEH PITCH	SXX.XXXX	+01.1111
VEH ROLL	SXX.XXXX	-03.2222
VEH YAW	SXX.XXXX	-08.1111
NADIR LAT	XX-XX.XXZ	11-11.55S
NADIR LONG	XXX-XX.XXZ	111-22.33W
CTR FORMAT LAT	XX-XX.XXZ	11-11.11N
CTR FORMAT LONG	XXX-XX.XXZ	111-11.11W
IN VELOCITY	XXXXX	25742

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GT VELOCITY	XXXXX	11111
IN AZIMUTH	XXX-XX	190-56
GT AZIMUTH	XXX-XX	111-11
EL-SUN	XX-XX	22-22
SUN-AZ	XXX-XX	122-22
ALTITUDE	XXXXXXX	0222222
SCAN RATE	X.XXX	1.222
FIRST GRID	XX-XX	01-11
SECOND GRID	XX-XX	11-12
ELEVATION	SXXXXX	-11111
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	11.1

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

X FID=+ 90000
Y FID=+ 0

SEND NEXT FID

X FID=+ 90000
Y FID=+ 100000

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

VIEWER INITIALIZED

CMCX= 0.00 MICRONS= 0 COUNTS
CMCY= 0.00 MICRONS= 0 COUNTS
LAT= 10D 38M .6S S
LONG= 110D 52M 48.7S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1328

POINTING COUNT= 5 FILM DRIFT= 0.00 MICRONS

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C4B OPTION

OBTAINING
PARAMETERS

You will be responsible for obtaining all parameters needed for each use of the program. Parameters will identify the film being processed, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional.

Before using the program, assemble all required parameters. These parameters and their sources are listed in Table 12. Most parameters appear on the MPF listing for the mission and bucket from which the photography was derived.

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Table 12. Parameters Needed for C4B Option

Parameter	Source
System name; C4B	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must determine
Mission number	Film
Pass number	Film
Frame number	Film
Camera A or F; A for aft looking camera; F for forward looking camera	Film
Focal length; millimeters	MPF listing
Vehicle pitch; degrees	MPF listing
Vehicle roll; degrees	MPF listing
Vehicle yaw; degrees	MPF listing
Nadir latitude; degrees, minutes, & direction	MPF listing
Nadir longitude; degrees, minutes, & direction	MPF listing
Center of format latitude; degrees, minutes, & direction	MPF listing
Center of format longitude; degrees, minutes, & direction	MPF listing

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Table 12. Parameters Needed for C4B Option (Continued)

Inertial velocity; feet per second	Orbital Mission Listing for the mission from which the film was derived for all missions prior to [redacted] if the Orbital Mission Listing is not available, use the ground track velocity in place of the inertial velocity & the program will make the necessary changes needed for correct calculations; for mission [redacted] & all subsequent missions see the MPF listing
Ground track velocity; feet per second	MPF listing
Inertial azimuth; degrees & minutes	Orbital Mission Listing for the mission from which the film was derived for all missions prior to [redacted] if the Orbital Mission Listing is not available, use the ground track azimuth in place of the inertial azimuth & the program will make the necessary changes needed for correct calculations; for mission [redacted] & all subsequent missions see the MPF listing
Ground track azimuth; degrees & minutes	MPF listing
Sun elevation; degrees & minutes	MPF listing
Sun azimuth; degrees & minutes	MPF listing
Altitude; feet	MPF listing
Scan rate; radians per second	MPF listing
First grid; x & y grid coordinates of first grid endpoint; centimeters	You measure & record
Second grid; x & y grid coordinates of second grid endpoint; centimeters	You measure & record

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Table 12. Parameters Needed for C4B Option (Continued)

Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis---	6378177.8 m.
		Semi-minor axis---	6356796.05 m.
		E^2 ---	.006693422
Krassovsky	KVY	Semi-major axis---	6378245.0 m.
		Semi-minor axis---	6356863.0188 m.
		E^2 ---	.006693422
International	INT	Semi-major axis---	6378388.0 m.
		Semi-minor axis---	6356911.9961 m.
		E^2 ---	.006722670
Clarke 1866	CRK	Semi-major axis---	6378206.4 m.
		Semi-minor axis---	6356583.8 m.
		E^2 ---	.006768658
Bessel	BSL	Semi-major axis---	6377397.155 m.
		Semi-minor axis---	6356078.9628 m.
		E^2 ---	.006674372
Army Map Service	AMS	Semi-major axis---	6378270.0 m.
		Semi-minor axis---	6356794.3434 m.
		E^2 ---	.006722670

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MEASURING GRID
COORDINATES

Mount the film positive, emulsion side up, on a light table. To measure the grid coordinates, place a Universal Grid Number 4-B over or under the frame so that the grid numbers read correctly. Align the grid so that

* the x = 0 line is along the left format edge, and

* the y = 0 line is along the bottom format edge

With a pinpoint or by some other method, mark the end points of the longest line segment (usually diagonal) that can be drawn through the target area. These end points must fall on grid intersections. Record the grid coordinates of these two points and note the order in which you recorded them. Cut the chip from the frame.

INITIALIZING
A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed and the camera system that produced the photography. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)
Type	INIT
Press	RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

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Next,

Type C4B

Press RETURN key

You will then receive this message:

LOAD CHIP

Load the film positive on the comparator. Procedures for placing the chips can be found in CHAPTER II, THE EQUIPMENT.

SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message:

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 111105

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Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the correct character. The incorrect character will remain on the printed page. For example:

ENTER SYSTEM NAME C4C↑B

You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example:

ENTER SYSTEM NAME		C4B	
LOAD FILM			
PROJECT NUMBER	XXXXXX	111052	
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	111050	RETURN key
EMULSION	ZZ		

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You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters.

For example,

ENTER SYSTEM NAME		C4B	
LOAD FILM			
PROJECT NUMBER	XXXXXX	111052	
EMULSION	ZZ	UP	
MISSION	XXXX-X	DELET	RETURN key
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	111050	RETURN key
EMULSION	ZZ		

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

Correcting an Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simple type TERM and then press the RETURN key. The teletype will print TERM.

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INITIALIZING
A COMPARATOR

After you have submitted all parameters, this message will appear on the teletype you are using:

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit the grid points to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the comparator crosshairs over the point entered as the first grid. Transmit this point to the program by pressing the FIDUCIAL button. You will then receive the coordinates of this grid point on the teletype. You will also receive this message:

SEND NEXT FIDUCIAL

Position the crosshairs over the point entered as the second grid. Transmit this point to the program by pressing the FIDUCIAL button. You will receive the coordinates of this grid point. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

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TRANSMITTING POINTS
FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.

2. Release any output function buttons that may have been pressed.

3. Press the appropriate output function buttons for the calculations you want.

4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

TERMINATING FRAME
OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over the first grid point. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

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Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

FRAME OPERATIONS TERMINATED DATE TIME
POINTING COUNT = XX FILM DRIFT = XX.XX MICRONS

The pointing count is the total number of points transmitted including grid points. Film drift is the distance the film has moved at the first grid point from the time the grid points were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		C4B
LOAD CHIP		
PROJECT NUMBER	XXXXXX	111105
EMULSION	ZZ	UP
MISSION	XXXX-X	
PASS	XXXZ	111A
FRAME	XXX	222
CAMERA A OR F	Z	F
FOCAL LENGTH	XXX.XXX	222.222
VEH PITCH	SXX.XXXX	-11.1111
VEH ROLL	SXX.XXXX	-12.1212
VEH YAW	SXX.XXXX	+00.1111
NADIR LAT	XX-XX.XXZ	22-22.22S
NADIR LONG	XXX-XX.XXZ	122.22.22W
CTR FORMAT LAT	XX-XX.XXZ	11-11.11N
CTR FORMAT LONG	XXX-XX.XXZ	111-11.11W
IN VELOCITY	XXXXX	25742
GT VELOCITY	XXXXX	25000
IN AZIMUTH	XXX-XX	190-56
GT AZIMUTH	XXX-XX	080-00
EL-SUN	XX-XX	08-09
SUN-AZ	XXX-XX	088-00
ALTITUDE	XXXXXXX	1111111
SCAN RATE	X.XXX	1.112
FIRST GRID	XX-XX	00-02
SECOND GRID	XX-XX	11-19

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```
ELEVATION       SXXXXX      +00101
ELLIPSOID       ZZZ         MCD
PLOT DIST       XX.X        28.0

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

X FID=+ 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 90000
Y FID=+ 100000

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

VIEWER INITIALIZED

CMCX= 0.00 MICRONS
CMCY= 100000.00 MICRONS
LAT= 19D 52M 47.2S S
LONG= 129D 5M 51.7S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73    1332+

POINTING COUNT= 5    FILM DRIFT= 0.00 MICRONS
```


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C4BR OPTION

OBTAINING
PARAMETERS

Except for the parameters available from the MPF, you will be responsible for obtaining the parameters needed for each use of the program. These parameters will identify the film you are processing, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional. Before you use the program, assemble all required parameters. These parameters and their sources are listed in Table 13.

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Table 13. Parameters Needed for C4BR Option

Parameter	Source
System name; C4BR	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must determine
Mission number	Film
Pass number	Film
Frame number	Film
Camera A or F; A for aft looking camera; F for forward looking camera	Film
First grid; x & y grid coordinates of first grid endpoint; centimeters	You measure & record
Second grid; x & y grid coordinates of second grid endpoint; centimeters	You measure & record
Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis---	6378177.8 m.
		Semi-minor axis---	6356796.05 m.
		E^2 ---	.006693422
Krassovsky	KVY	Semi-major axis---	6378245.0 m.
		Semi-minor axis---	6356863.0188 m.
		E^2 ---	.006693422
International	INT	Semi-major axis---	6378388.0 m.
		Semi-minor axis---	6356911.9961 m.
		E^2 ---	.006722670
Clarke 1866	CRK	Semi-major axis---	6378206.4 m.
		Semi-minor axis---	6356583.8 m.
		E^2 ---	.006768658
Bessel	BSL	Semi-major axis---	6377397.155 m.
		Semi-minor axis---	6356078.9628 m.
		E^2 ---	.006674372
Army Map Service	AMS	Semi-major axis---	6378270.0 m.
		Semi-minor axis---	6356794.3434 m.
		E^2 ---	.006722670

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MEASURING GRID
COORDINATES

Mount the film positive, emulsion side up, on a light table. To measure the grid coordinates, place a Universal Grid Number 4-B over or under the frame so that the grid numbers read correctly. Align the grid so that

* the x = 0 line is along the left format edge, and

* the y = 0 line is along the bottom format edge

With a pinpoint or by some other method, mark the end points of the longest line segment (usually diagonal) that can be drawn through the target area. These end points must fall on grid intersections. Record the grid coordinates of these two points and note the order in which you recorded them. Cut the chip from the frame.

INITIALIZING
A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed and the camera system that produced the photography. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL & U keys (simultaneously)
Type	INIT
Press	RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

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Next,

Type C4BR

Press RETURN key

You will then receive this message:

LOAD CHIP

Load the film positive on the comparator. Procedures for placing the chips can be found in CHAPTER II, THE EQUIPMENT.

SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 111105

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Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the correct character. The incorrect character will remain on the printed page. For example:

ENTER SYSTEM NAME C4BT↑R

You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

ENTER SYSTEM NAME		C4BR	
LOAD FILM			
PROJECT NUMBER	XXXXXX	111052	
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	111050	RETURN key
EMULSION	ZZ		

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You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters.

For example,

ENTER SYSTEM NAME		C4BR	
LOAD FILM			
PROJECT NUMBER	XXXXXX	111052	
EMULSION	ZZ	UP	
MISSION	XXXX-X	DELET	RETURN key
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	111050	RETURN key

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

Correcting an Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simply type TERM and then press the RETURN key. The teletype will print TERM.

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INITIALIZING
A COMPARATOR

After you have submitted your parameters and the MPF retrieval has been successfully completed, you will receive one of the following two messages:

* READY W S.R.-SEND FIRST FIDUCIAL
  appears if stellar-derived attitude of pan camera is available, or

* READY W/O S.R.-SEND FIRST FIDUCIAL
  appears if stellar-derived attitude of pan camera is not available

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit the grid points to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the comparator crosshairs over the point entered as the first grid. Transmit this point to the program by pressing the FIDUCIAL button. You will then receive the coordinates of this grid point on the teletype. You will also receive this message:

SEND NEXT FIDUCIAL

Position the crosshairs over the point entered as the second grid. Transmit this point to the program by pressing the FIDUCIAL button. You will receive the coordinates of the second grid point on the teletype. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype or in the retrieved information. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

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TRANSMITTING POINTS FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.
2. Release any output function buttons that may have been pressed.
3. Press the appropriate output function buttons for the calculations you want.
4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

TERMINATING FRAME OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over the first grid point. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

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Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

```
FRAME OPERATIONS TERMINATED    DATE    TIME
POINTING COUNT = XX    FILM DRIFT = XX.XX MICRONS
```

The pointing count is the total number of points transmitted including grid points. Film drift is the distance the film has moved at the first grid point from the time the grid points were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

SAMPLE TELETYPE
OUTPUT

```
ENTER SYSTEM NAME              C4BR
LOAD CHIP
PROJECT NUMBER  XXXXXX         111105
EMULSION        ZZ             UP
MISSION         XXXX-X         [redacted]
PASS            XXXZ           111A
FRAME           XXX            222
CAMERA A OR F   Z              F
FIRST GRID      XX-XX          00-02
SECOND GRID     XX-XX          11-19
ELEVATION       SXXXXX         +00101
ELLIPSOID       ZZZ            MCD
PLOT DIST       XX.X           28.0

READY W/O S.R.-SEND FIRST FIDUCIAL

X FID=+ 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 1679
Y FID=+ 8562

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG
```


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VIEWER INITIALIZED

LAT= 5D 20M 42.3S S
LONG= 170D 13M 16.3S E

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN 10,73

POINTING COUNT= 5 FILM DRIFT= 210276.50 MICRONS

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SK4A, SK4B, SK4BR, SC4A, SC4B, AND SC4BR OPTIONS

OBTAINING PARAMETERS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. All the parameters needed to use a stereoscopic option will be found in the parameter table. However, those parameters listed in the table that fall between "Emulsion" and "Elevation" must be obtained for both frames or chips.

CHOOSING ELLIPSOIDS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use.

MARKING FIDUCIALS OR MEASURING GRID COORDINATES

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. The procedures for marking fiducials or measuring grid coordinates for a stereoscopic option are the same as those for a monoscopic option except that you must mark fiducials or measure grid coordinates for both frames or chips.

INITIALIZING A TELETYPE

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use.

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SUBMITTING
PARAMETERS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. The procedures for submitting parameters for a stereoscopic option are the same as those for a monoscopic option with the following exception. When using a stereoscopic option, the program will request some of the parameters twice. The first request will be for all the parameters for the left frame or chip and the second will be for the right frame or chip.

INITIALIZING
A COMPARATOR

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. The procedures for initializing a comparator for a stereoscopic option are the same as those for a monoscopic option with the following exception. You must transmit fiducials or grid points for both frames or chips. Transmit the fiducials or grid points for the left frame or chip first.

RELATIVE
ORIENTATION

The relative orientation (R/O) of the frames or chips you are viewing with respect to each other should result in more accurate measurements. To calculate the relative orientation you must transmit from 6 to 20 corresponding points (R/O points) on each frame or chip simultaneously. These points must be as close as possible to the same ground elevation. Before transmitting the R/O points you must press the R/O output function button. The program is now ready to receive the R/O points.

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Transmitting
R/O Points

Move the crosshairs over the first R/O point to be transmitted. Send this point as an initial point. You will receive this message:

SEND NEXT POINT

Except for the last R/O point all R/O points must be sent as initial points. Each time you send an R/O point as an initial point, you will receive this message:

SEND NEXT POINT

Send the last R/O point as a terminal point. At this time an additional pitch, roll, and yaw will be calculated and printed on the teletype along with the following message:

PITCH = -OD 1M 20.9S
YAW = -OD 10M 22.9S
ROLL = +OD 5M 21.9S

RE-SET R/O SWITCH

Release the R/O button.

If you choose, you may have the coordinates of the R/O points printed on the teletype. To do this press the CMC ECHO button before you transmit the R/O points. Every time you send an R/O point as an initial point, you will receive this message:

SEND NEXT POINT

CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS
CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS

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When you transmit the terminal R/O point, you will receive this message:

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

RE-SET R/O SWITCH

CMCX = XXXXX.X	MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X	MICRONS = XXXXXX COUNTS
CMCX = XXXXX.X	MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X	MICRONS = XXXXXX COUNTS

Should you make an error while transmitting the R/O points, you can correct it by deleting the erroneous transmission. For example, if you send an incorrect R/O point as an initial point, you can delete that transmission by sending an intermediate point. You will receive this message:

LAST POINT DELETED

If you have transmitted several erroneous initial points, send the same number of intermediate points, and when the last intermediate point is received, you will receive this message:

ALL POINTS DELETED

After you have transmitted the R/O points and received the additional pitch, roll, and yaw, you are ready to transmit points for mensural calculations as described in the following section. However, if you find that the additional pitch, roll, and yaw do not result in more accurate calculations, you can nullify the relative orientation or recalculate it.

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Nullifying The
Relative Orientation

To nullify the relative orientation, release the R/O button and press the SET R/O TO IDENTITY button. Transmit a point for mensural calculations. You will receive the mensural output requested and this message:

R/O SET TO IDENTITY MATRIX

You are ready to continue transmitting points for mensural calculations without the additional pitch, roll, and yaw.

Recalculating The
Relative Orientation

To recalculate the relative orientation, first nullify it, and then recalculate the relative orientation according to the procedures described above.

TRANSMITTING POINTS
FOR CALCULATIONS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you are using.

SWITCHING FROM A STEREO
OPTION TO A MONO OPTION

When you are using a stereo comparator, you can switch to a monoscopic option for either the left or right stage and back to stereo without reinitializing the comparator by turning the second rotary switch in the first

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row of rotary switches to the setting which corresponds to the option you want. The second rotary switch settings and the options are:

Second Rotary Switch Setting	Option
Ø	Stereo
1	Mono - left stage
2	Mono - right stage

You must also turn the first rotary switch which indicates the output functions you will use to the desired setting. There are different settings for stereoscopic and monoscopic options. (See CHAPTER II, USING THE OUTPUT FUNCTION BUTTONS section.)

When switching from one option to another, the first point transmitted after turning the first and second rotary switches to the desired settings must be an initial point. After sending an initial point, you will receive one of the following messages which indicates which option has been selected prior to any printed output:

BOTH FRAMES - STEREO
RIGHT FRAME
LEFT FRAME

If the first point transmitted is other than an initial point, you will receive the following message:

ILLEGAL POINT SEQUENCE

If you receive this message, transmit the next point as an initial point.

TERMINATING FRAME
OPERATIONS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you are using.

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SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		SK4A
LOAD FILM		
PROJECT NUMBER	XXXXXX	111050
EMULSION	ZZ	UP
X1 MISSION	XXXX-X	[redacted]
PASS	XXXZ	111D
FRAME	XXX	111
CAMERA A OR F	Z	F
FOCAL LENGTH	XXX.XXX	111.111
VEH PITCH	SXX.XXXX	+11.1111
VEH ROLL	SXX.XXXX	-11.1111
VEH YAW	SXX.XXXX	+11.1111
NADIR LAT	XX-XX.XXZ	22-22.22N
NADIR LONG	XXX-XX.XXZ	111-11.11W
CTR FORMAT LAT	XX-XX.XXZ	11-11.11N
CTR FORMAT LONG	XXX-XX.XXZ	111-11.11W
IN VELOCITY	XXXXX	25742
GT VELOCITY	XXXXX	11111
IN AZIMUTH	XXX-XX	190-56
GT AZIMUTH	XXX-XX	111-11
EL-SUN	XX-XX	11-11
SUN-AZ	XXX-X	111-11
ALTITUDE	XXXXXXX	1111111
SCAN RATE	X.XXX	1.111
MISSION	XXXX-X	1050-1
PASS	XXXZ	111D
FRAME	XXX	112
CAMERA A OR F	Z	A
FOCAL LENGTH	XXX.XXX	111.111
VEH PITCH	SXX.XXXX	+12.1111
VEH ROLL	SXX.XXXX	-12.1111
VEH YAW	SXX.XXXX	+12.1111
NADIR LAT	XX-XX.XXZ	22-21.22N
NADIR LONG	XXX-XX.XXZ	111-12.11W
CTR FORMAT LAT	XX-XX.XXZ	12-11.11N
CTR FORMAT LONG	XXX-XX.XXZ	112-11.11W
IN VELOCITY	XXXXX	25743
GT VELOCITY	XXXXX	11112
IN AZIMUTH	XXX-XX	190-55
GT AZIMUTH	XXX-XX	111-10
EL-SUN	XX-XX	12-11
SUN-AZ	XXX-XX	112-11
ALTITUDE	XXXXXXX	1111122

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```
SCAN RATE       X.XXX        1.112
ELEVATION       SXXXXX       +01111
ELLIPSOID       ZZZ          MCD
PLOT DIST       XX.X         09.0

INITIALIZE VIEWER--SEND LEFT FRAME FIDUCIALS

X FID=- 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 90000
Y FID=+ 0

BEGIN RIGHT FRAME

SEND NEXT FID

X FID=+ 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 244
Y FID=+ 87430

LEFT FRAME

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

RIGHT FRAME

DOF AZIM= 205.448 DEG
IN AZIM= 202.992 DEG

VIEWER INITIALIZED

BOTH FRAMES STEREO

SEND NEXT POINT

CMCX = 11122.2  MICRONS = 111211 COUNTS
CMCY = 11111.1  MICRONS = 111112 COUNTS
CMCX = 11133.2  MICRONS = 111333 COUNTS
CMCY = 11444.1  MICRONS = 114443 COUNTS
```


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SEND NEXT POINT

CMCX = 22211.1 MICRONS = 222112 COUNTS
CMCY = 11110.0 MICRONS = 111111 COUNTS
CMCX = 33112.2 MICRONS = 332221 COUNTS
CMCY = 11122.3 MICRONS = 111224 COUNTS

SEND NEXT POINT

CMCX = 44422.1 MICRONS = 444222 COUNTS
CMCY = 44433.2 MICRONS = 444331 COUNTS
CMCX = 33322.1 MICRONS = 333211 COUNTS
CMCY = 33333.2 MICRONS = 333333 COUNTS

SEND NEXT POINT

CMCX = 55544.3 MICRONS = 555442 COUNTS
CMCY = 55443.2 MICRONS = 554431 COUNTS
CMCX = 55432.1 MICRONS = 554322 COUNTS
CMCY = 54433.3 MICRONS = 544332 COUNTS

SEND NEXT POINT

CMCX = 66665.4 MICRONS = 666653 COUNTS
CMCY = 66655.3 MICRONS = 666552 COUNTS
CMCX = 66644.4 MICRONS = 666443 COUNTS
CMCY = 66554.3 MICRONS = 665542 COUNTS

RE-SET R/O SWITCH

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

CMCX = 77665.5 MICRONS = 776654 COUNTS
CMCY = 77655.4 MICRONS = 776553 COUNTS
CMCX = 77754.3 MICRONS = 777542 COUNTS
CMCY = 77644.2 MICRONS = 776441 COUNTS

LAT = 34D 39M 28.8S N
LONG = 86D 40M 25.6S W
HEIGHT = 1699.7326 FT

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LEFT FRAME

LAT = 34D 39M 28.1S N
LONG = 86D 40M 21.0S W
GROUNDX = 89552.7 FT = 27295.7 METERS
GROUNDY = 68158.8 FT = -20774.8 METERS
GROUNDZ = 454704.9 FT = -141642.3 METERS

RIGHT FRAME

LAT = 34D 39M 30.4S N
LONG = 86D 40M 33.9S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1332+

POINTING COUNT= 18

DRIFT1= 0.00 MICRONS DRIFT2= 0.05 MICRONS

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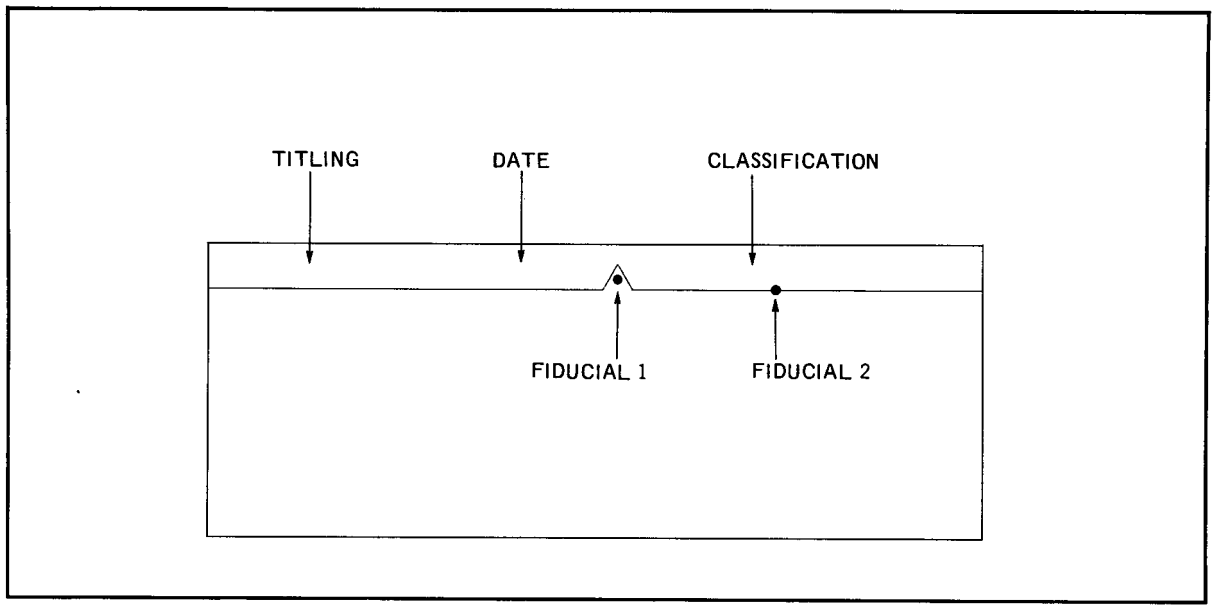

FIGURE 14. MARKING FIDUCIALS ON KH-4A PHOTOGRAPHY, EMULSION SIDE UP.

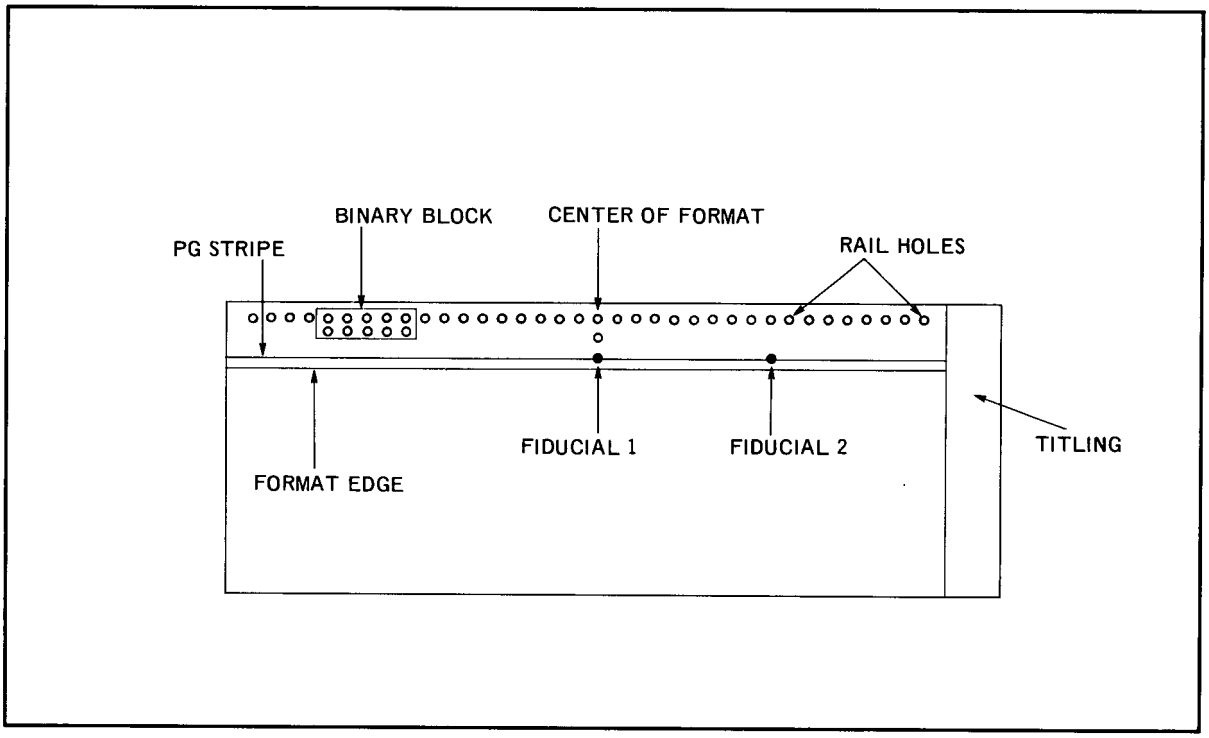

FIGURE 15. MARKING FIDUCIALS ON KH-4B PHOTOGRAPHY, EMULSION SIDE UP.

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CHAPTER IV. PROCESSING PHOTOGRAPHY FROM THE KH-7 CAMERA SYSTEM

Using the Real-Time Mensuration Program to process photography derived from the KH-7 camera system will involve these steps in the order listed.

STEP 1 obtaining parameters

STEP 2 choosing ellipsoids

STEP 3 marking fiducials (or measuring grid coordinates)

STEP 4 initializing a teletype

STEP 5 submitting parameters

STEP 6 initializing a comparator

STEP 7 transmitting points for calculations

STEP 8 terminating frame operations

There are several options under which you may process KH-7 photography. However, parameters for KH-7 missions are not included in the MPF, and there is no capability for using variable filmspeed. The options are these:

Monoscopic Options

K7A frame of photography; average filmspeed

C7A chip of photography; average filmspeed

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Stereoscopic Options

SK7A two frames of stereo photography; average filmspeed

SC7A two chips of stereo photography; average filmspeed

When using any of the stereoscopic options, two additional steps are available. They are:

* transmitting relative orientation (R/O) points to calculate the relative orientation of the two frames or chips of photography

* switching to the corresponding monoscopic option for either the left or right stage

Both of these steps are optional.

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K7A OPTION

OBTAINING
PARAMETERS

You will be responsible for obtaining all parameters needed for each use of the program. Parameters will identify the film being processed, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional.

Before you use the program, assemble all required parameters. These parameters and their sources are listed in Table 14. Most parameters can be found in the Mission Correlation Data (MCD) for the mission from which the film was derived. Many requests via the teletype for parameters will be followed by

* T1; indicating the value of that parameter recorded at camera "on" time

or

* T2; indicating the value of that parameter recorded at camera "off" time

Both of these values can be obtained from the MCD.

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Table 14. Parameters Needed for K7A Option

Parameter	Source
System name; K7A	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must determine
Fiducials; 2 or 5	You decide the number of fiducials you want to transmit
Mission number	Film
Revolution number	MCD
Accession number	Film
Focal length; inches	MCD
Mirror pitch; degrees	MCD
Mirror crab; degrees	MCD
Vehicle pitch; stellar-reduced pitch of index camera; degrees; if unknown, enter zero	Output listing from Stellar Reduction System
Vehicle roll; stellar-reduced roll of index camera; degrees; if unknown, enter zero	Output listing from Stellar Reduction System
Vehicle yaw; stellar-reduced inertial yaw of index camera; degrees; if unknown, enter zero	Output listing from Stellar Reduction System
Nadir-latitude T1; degrees, minutes, & direction	MCD

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Table 14. Parameters Needed for K7A Option (Continued)

Nadir-latitude T2; degrees, minutes, & direction	MCD
Nadir-longitude T1; degrees, minutes & direction	MCD
Nadir-longitude T2; degrees, minutes & direction	MCD
Inertial velocity T1; feet per second	MCD
Inertial velocity T2; feet per second	MCD
Vehicle azimuth T1; degrees	MCD
Vehicle azimuth T2; degrees	MCD
Flight path T1; degrees	MCD
Flight path T2; degrees	MCD
Sun elevation T1; degrees	MCD
Sun elevation T2; degrees	MCD
Sun azimuth T1; degrees	MCD
Sun azimuth T2; degrees	MCD
Height T1; nautical miles	MCD
Height T2; nautical miles	MCD
Velocity of film; inches per second	MCD

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Table 14. Parameters Needed for K7A Option (Continued)

Target T/D; time or distance from T1 to fiducial 1; may be in any units including fractions of a second of time; for more accurate results, point the index bit of a PCT word as fiducial 1, then count the number of PCT words from T1 to fiducial 1; count T1 as zero	You measure & record
Total T/D; time or distance from T1 to T2; must be in same units as Target T/D; for more accurate results, count the number of PCT words from T1 to T2; count T1 as zero	You measure & record
Payload clock time T1; octal number	MCD or you determine from film
Payload clock time T2; octal number	MCD or you determine from film
Shrinkage factor; meas/nominal	MCD
Slit length; microns	MCD
Translation; microns	Camera Calibration Information Catalogue
Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis---	6378177.8 m.
		Semi-minor axis---	6356796.05 m.
		E^2 ---	.006693422
Krassovsky	KVY	Semi-major axis---	6378245.0 m.
		Semi-minor axis---	6356863.0188 m.
		E^2 ---	.006693422
International	INT	Semi-major axis---	6378388.0 m.
		Semi-minor axis---	6356911.9961 m.
		E^2 ---	.006722670
Clarke 1866	CRK	Semi-major axis---	6378206.4 m.
		Semi-minor axis---	6356583.8 m.
		E^2 ---	.006768658
Bessel	BSL	Semi-major axis---	6377397.155 m.
		Semi-minor axis---	6356078.9628 m.
		E^2 ---	.006674372
Army Map Service	AMS	Semi-major axis---	6378270.0 m.
		Semi-minor axis---	6356794.3434 m.
		E^2 ---	.006722670

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DETERMINING PAYLOAD
CLOCK TIME

When using this option the program requires the payload clock time (PCT) at time 1 and the PCT at time 2 as parameters. You can obtain this information from the MCD or read the PCT directly from the film. On a KH-7 time track payload clock time is represented by PCT "words" consisting of 23 binary digits or bits, i.e., Ø and 1.* (See Figure 16 which appears at the end of this chapter.) A twenty-fourth bit is assumed to be present and is considered to be OFF. The least significant bit in the PCT word is the index bit which is always ON. This bit is also one of the bits in the 20-cycle time track. Beginning with the least significant bit and moving to the left, divide the bits into groups of three binary digits. Convert each group of three bits to its corresponding octal number. Binary numbers and their octal equivalents are listed below.

Binary Numbers	Corresponding Octal Numbers
ØØØ	Ø
ØØ1	1
Ø1Ø	2
Ø11	3
1ØØ	4
1Ø1	5
11Ø	6
111	7

* Binary digit Ø is OFF; binary digit 1 is ON. The bits that are physically present on the time track are ON bits. The absence of a bit indicates an OFF bit.

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MARKING
FIDUCIALS

When using this option you have the choice of transmitting two or five fiducials. Transmitting five fiducials should result in more accurate mensural output.

Marking Two Fiducials

Mount the film positive, emulsion side up, on a light table. The titling will be at the top of the frame, but it will not be in the correct reading position. Note the series of small, collinear time marks at the bottom of the film. This is a time track. With a grease pencil or by some other method, circle the time track at a point which is at least four inches from the left edge of the frame. This circle should be directly opposite the target area if possible. One of the time marks in this circle will be fiducial 1. Circle another area on the time track about two to four inches to the left of the first circle. One of the time marks in this circle will be fiducial 2. (See Figure 17 which appears at the end of this chapter.)

Marking Five Fiducials

Mount the film positive, emulsion side up, on a light table. The titling will be at the top of the frame, but it will not be in the correct reading position. With a grease pencil or by some other method, circle the five fiducials on the film positive. Fiducial 1 is the index bit of the PCT word closest to the target area (the reference PCT word). Fiducials 2 and 3 may be any points along the bottom edge of the imagery, but the position of fiducial 3 in relation to fiducial 2 must be in the direction of "time on." In other words, if an arrow were drawn from fiducial 3 to fiducial 2, it would indicate the direction of flight. Fiducials 4 and 5 may be in either order along the top edge of the imagery, but they must be the same distance from the longitudinal center line as fiducials 2 and 3. (See Figure 18 which appears at the end of this chapter.)

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INITIALIZING
A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed and the camera system that produced that photography. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)
Type	INIT
Press	RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

Next,

Type	K7A
Press	RETURN key

You will then receive this message:

LOAD FILM

Load the film positive on a comparator. Procedures for mounting film on a comparator will depend on which comparator you use. These procedures can be found in CHAPTER II, THE EQUIPMENT.

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SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 920022

Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then

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type the correct character. The incorrect character will remain on the printed page. For example:

```
ENTER SYSTEM NAME     K7C↑A
```

You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

```
ENTER SYSTEM NAME              K7A
LOAD FILM
PROJECT NUMBER       XXXXXX    920032
EMULSION             ZZ        DELET     RETURN key
PROJECT NUMBER       XXXXXX    920022    RETURN key
EMULSION             ZZ
```

You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters. For example,

```
ENTER SYSTEM NAME              K7A
LOAD FILM
PROJECT NUMBER       XXXXXX    920032
EMULSION             ZZ        DN
FIDUCIALS            X         DELET     RETURN key
EMULSION             ZZ        DELET     RETURN key
PROJECT NUMBER       XXXXXX    920022    RETURN key
EMULSION             ZZ
```


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Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

Correcting an Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simply type TERM and then press the RETURN key. The teletype will print TERM.

INITIALIZING A COMPARATOR

After you have submitted all parameters, this message will appear on the teletype you are using:

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit fiducials to the program to establish a coordinate system. Whether you transmit two fiducials or five fiducials will depend on the number you input as a parameter.

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Transmitting
Two Fiducials

Using the X and Y drive and the X and Y wheels, place the crosshairs over the area circled earlier for fiducial 1. Select one of the time marks in the circle. For best results, place the crosshairs over a point on this time mark so that a corresponding point can be easily located on the time mark you select for fiducial 2. For example, select one corner of this time mark. Transmit this corner as fiducial 1 by pressing the FIDUCIAL button. You will receive the coordinates of fiducial 1 via the teletype. You will also receive this message:

SEND NEXT FIDUCIAL

Move the crosshairs to the other circled area and select a time mark. Position the crosshairs over the corner on this time mark that corresponds to the one selected for fiducial 1. Transmit this corner as fiducial 2 by pressing the FIDUCIAL button. You will receive the coordinates of fiducial 2 on the teletype. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

Transmitting
Five Fiducials

Using the X and Y drive and the X and Y wheels, move the crosshairs over the index bit of the PCT word closest to the target area (the reference PCT word) circled as fiducial 1. Transmit this point as fiducial 1 by pressing the FIDUCIAL button. You will receive the coordinates of fiducial 1 via the teletype. You will also receive this message:

SEND NEXT FIDUCIAL

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Move the crosshairs to the point circled for fiducial 2. Transmit this point as fiducial 2 by pressing the FIDUCIAL button. Transmit fiducials 3, 4, and 5 in the same manner. After each fiducial is transmitted, you will receive its coordinates on the teletype, and except for fiducial 5, you will also receive this message:

SEND NEXT FIDUCIAL

After fiducial 5 has been transmitted, the direction of flight azimuth and the inertial azimuth will be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

TRANSMITTING POINTS
FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.
2. Release any output function buttons that may have been pressed.
3. Press the appropriate output function buttons for the calculations you want.
4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

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Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

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TERMINATING FRAME OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over fiducial 1. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

FRAME OPERATIONS TERMINATED DATE TIME
POINTING COUNT = XX FILM DRIFT = XX.XX MICRONS

The pointing count is the total number of points transmitted including fiducials. Film drift is the distance the film has moved at fiducial 1 from the time the fiducials were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

SAMPLE TELETYPE OUTPUT

ENTER SYSTEM NAME		K7A
LOAD FILM		
PROJECT NUMBER	XXXXXX	920022
EMULSION	ZZ	DN
FIDUCIALS	X	2
MISSION	XXXX	[redacted]
REV	XXX	090

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ACC	XXX	008
FOCAL LENGTH	XXX.XX	120.09
MIRROR PITCH	SXX.XXXX	-09.0066
MIRROR CRAB	SXX.XXX	-00.456
VEH PITCH	SXX.XXXX	+03.0600
VEH ROLL	SXX.XXX	+10.444
VEH YAW	SXX.XXXX	+01.1600
NADIR-LAT T1	XX-XX.XXZ	23-55.11S
NADIR-LAT T2	XX-XX.XXZ	23-50.23S
NADIR-LONG T1	XXX-XX.XXZ	123-09.44E
NADIR-LONG T2	XXX-XX.XXZ	123-12.23E
INER VEL T1	XXXXX.XX	25000.09
INER VEL T2	XXXXX.XX	24998.90
VEH AZIM T1	XXX.XXX	089.098
VEH AZIM T2	XXX.XXX	087.087
FLT PTH/T1	SX.XXXX	+1.0990
FLT PTH/T2	SX.XXXX	+1.1100
EL-SUN T1	XX.X	45.0
EL-SUN T2	XX.X	45.0
SUN-AZ T1	XXX.X	100.0
SUN-AZ T2	XXX.X	100.0
HEIGHT T1	XXX.XXX	090.090
HEIGHT T2	XXX.XXX	088.089
VF	XX.XXXX	03.0996
TARGET T/D	XX.XXX	21.090
TOTAL T/D	XX.XXX	50.000
PCT T1	XXXXXXXX	12345670
PCT T2	XXXXXXXX	01234567
SHRINK	X.XXXX	0.3343
SLIT LENGTH	X.XXXXX	0.44297
TRANSLATION	XXXXXX	221569
ELEVATION	SXXXXX	+23578
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	25.9

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

X FID=+ 2066
Y FID=+ 10090

SEND NEXT FID

X FID=+ 90090
Y FID=+ 190000

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DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

VIEWER INITIALIZED

AZIMUTH= 3.96 DEG

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1559

POINTING COUNT= 5 FILM DRIFT= 6.50 MICRONS

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C7A OPTION

OBTAINING
PARAMETERS

You will be responsible for obtaining all parameters needed for each use of the program. Parameters will identify the film being processed, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional.

Before you use the program, assemble all required parameters. These parameters and their sources are listed in Table 15. Most parameters can be found in the Mission Correlation Data (MCD) for the mission from which the film was derived. Many requests via the teletype for parameters will be followed by

* T1; indicating the value of that parameter recorded at camera "on" time

or

* T2; indicating the value of that parameter recorded at camera "off" time

Both of these values can be obtained from the MCD.

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Table 15. Parameters Needed for C7A Option

Parameter	Source
System name; C7A	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must determine
Mission number	Film
Revolution number	MCD
Accession number	Film
Focal length; inches	MCD
Mirror pitch; degrees	MCD
Mirror crab; degrees	MCD
Vehicle pitch; stellar-reduced pitch of index camera; degrees; if unknown, enter zero	Output listing from Stellar Reduction System
Vehicle roll; stellar-reduced roll of index camera; degrees; if unknown, enter zero	Output listing from Stellar Reduction System
Vehicle yaw; stellar-reduced inertial yaw of index camera; degrees; if unknown, enter zero	Output listing from Stellar Reduction System
Nadir-latitude T1; degrees, minutes, & direction	MCD
Nadir-latitude T2; degrees, minutes, & direction	MCD

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Table 15. Parameters Needed for C7A Option (Continued)

Nadir-longitude T1; degrees, minutes & direction	MCD
Nadir-longitude T2; degrees, minutes & direction	MCD
Inertial velocity T1; feet per second	MCD
Inertial velocity T2; feet per second	MCD
Vehicle azimuth T1; degrees	MCD
Vehicle azimuth T2; degrees	MCD
Flight path T1; degrees	MCD
Flight path T2; degrees	MCD
Sun elevation T1; degrees	MCD
Sun elevation T2; degrees	MCD
Sun azimuth T1; degrees	MCD
Sun azimuth T2; degrees	MCD
Height T1; nautical miles	MCD
Height T2; nautical miles	MCD
Velocity of film; inches per second	MCD
Target T/D; time or distance from T1 to first grid endpoint; may be in any units including fractions of a second of time	You measure & record
Total T/D; time or distance from T1 to T2; must be in same units as Target T/D	You measure & record

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Table 15. Parameters Needed for C7A Option (Continued)

Payload clock time T1; octal number	MCD or you determine from film
Payload clock time T2; octal number	MCD or you determine from film
First grid; x & y coordinates of first grid endpoint; centimeters	You measure & record
Second grid; x & y coordinates of second grid endpoint; centimeters	You measure & record
Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis---	6378177.8 m.
		Semi-minor axis---	6356796.05 m.
		E^2 ---	.006693422
Krassovsky	KVY	Semi-major axis---	6378245.0 m.
		Semi-minor axis---	6356863.0188 m.
		E^2 ---	.006693422
International	INT	Semi-major axis---	6378388.0 m.
		Semi-minor axis---	6356911.9961 m.
		E^2 ---	.006722670
Clarke 1866	CRK	Semi-major axis---	6378206.4 m.
		Semi-minor axis---	6356583.8 m.
		E^2 ---	.006768658
Bessel	BSL	Semi-major axis---	6377397.155 m.
		Semi-minor axis---	6356078.9628 m.
		E^2 ---	.006674372
Army Map Service	AMS	Semi-major axis---	6378270.0 m.
		Semi-minor axis---	6356794.3434 m.
		E^2 ---	.006722670

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DETERMINING PAYLOAD
CLOCK TIME

When using this option the program requires the payload clock time (PCT) at time 1 and time 2 as parameters. You can obtain this information from the MCD or read the PCT directly from the film. Payload clock time is represented on a time track by PCT "words" consisting of binary digits or bits, i.e., Ø and 1.* On a KH-7 time track the PCT word consists of 23 bits. (See Figure 16 which appears at the end of this chapter.) A twenty-fourth bit is assumed to be present and is considered to be OFF. The least significant bit in the PCT word is the index bit which is always ON. This bit is also one of the bits in the 20-cycle time track. Beginning with the least significant bit, and moving to the left, divide the bits into groups of three binary digits. Convert each group of three bits to its corresponding octal number. Binary numbers and their octal equivalents are listed below.

Binary Numbers	Corresponding Octal Numbers
ØØØ	Ø
ØØ1	1
Ø1Ø	2
Ø11	3
1ØØ	4
1Ø1	5
11Ø	6
111	7

* Binary digit Ø is OFF; binary digit 1 is ON. The bits that are physically present on the time track are ON bits. The absence of a bit indicates an OFF bit.

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MEASURING GRID COORDINATES

Mount the film positive, emulsion side down, on a light table. The titling will be at the top of the frame, and it will be in the correct reading position. To measure the grid coordinates, place a Universal Grid Number 1 over or under the film so that the grid numbers and grid titling read correctly. Position the grid so that

* the x = 46 line is aligned with the index bit to the left of the target, and

* the tick marks at y = 23.1 are aligned with the yaw slit line, which is a clear line imaged at the top of the frame approximately two millimeters from the format edge

With a pinpoint or by some other method, mark the end points of the longest line segment (usually diagonal) that can be drawn through the target area. These points must fall on grid intersections. Record the grid coordinates of these two points and note the order in which you recorded them. Cut the chip from the frame.

INITIALIZING A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed and the camera system that produced the photography. To initialize a teletype follow these instructions in the order given.

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Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)
Type	INIT
Press	RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

Next,

Type	C7A
Press	RETURN key

You will then receive this message:

LOAD CHIP

Load the film positive on the comparator. Procedures for placing the chips can be found in CHAPTER II, THE EQUIPMENT.

SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

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X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 920022

Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the correct character. The incorrect character will remain on the printed page. For example:

ENTER SYSTEM NAME C7C↑A

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You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

```
ENTER SYSTEM NAME              C7A
LOAD FILM
PROJECT NUMBER       XXXXXX    920032
EMULSION             ZZ        DELET     RETURN key
PROJECT NUMBER       XXXXXX    920022    RETURN key
EMULSION             ZZ
```

You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters. For example,

```
ENTER SYSTEM NAME              C7A
LOAD FILM
PROJECT NUMBER       XXXXXX    920032
EMULSION             ZZ        DN
MISSION              XXXX      DELET     RETURN key
EMULSION             ZZ        DELET     RETURN key
PROJECT NUMBER       XXXXXX    920022    RETURN key
EMULSION             ZZ
```

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

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Correcting an Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simply type TERM and then press the RETURN key. The teletype will print TERM.

INITIALIZING A COMPARATOR

After you have submitted all parameters, this message will appear on the teletype you are using:

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit grid points to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the comparator crosshairs over the point entered as the first grid. Transmit this point to the program by pressing the FIDUCIAL

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button. You will then receive the coordinates of this grid point on the teletype. You will also receive this message:

SEND NEXT FIDUCIAL

Position the crosshairs over the point entered as the second grid. Transmit this point to the program by pressing the FIDUCIAL button. You will receive the coordinates of the second grid point on the teletype. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

TRANSMITTING POINTS FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.
2. Release any output function buttons that may have been pressed.
3. Press the appropriate output function buttons for the calculations you want.
4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

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Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

TERMINATING FRAME
OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over the first grid point. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

FRAME OPERATIONS TERMINATED DATE TIME
POINTING COUNT = XX FILM DRIFT = XX.XX MICRONS

The pointing count is the total number of points transmitted including grid points. Film drift is the distance the film has moved at the first grid point from the time the grid points were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

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SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		C7A
LOAD CHIP		
PROJECT NUMBER	XXXXXX	920022
EMULSION	ZZ	DN
MISSION	XXXX	[redacted]
REV	XXX	009
ACC	XXX	008
FOCAL LENGTH	XXX.XX	120.00
MIRROR PITCH	SXX.XXXX	+09.2345
MIRROR CRAB	SXX.XXX	-05.678
VEH PITCH	SXX.XXXX	-03.0909
VEH ROLL	SXX.XXX	-05.678
VEH YAW	SXX.XXXX	+10.0000
NADIR-LAT T1	XX-XX.XXZ	23-23.23N
NADIR-LAT T2	XX-XX.XXZ	23-20.00N
NADIR-LONG T1	XXX-XX.XXZ	109-45.09E
NADIR-LONG T2	XXX-XX.XXZ	109-44.09E
INER VEL T1	XXXXX.XX	23456.00
INER VEL T2	XXXXX.XX	23400.00
VEH AZIM T1	XXX.XXX	234.234
VEH AZIM T2	XXX.XXX	230.090
FLT PTH/T1	SX.XXXX	+1.0098
FLT PTH/T2	SX.XXXX	+1.0909
EL-SUN T1	XX.X	45.0
EL-SUN T2	XX.X	45.0
SUN-AZ T1	XXX.X	100.0
SUN-AZ T2	XXX.X	100.0
HEIGHT T1	XXX.XXX	100.000
HEIGHT T2	XXX.XXX	098.098
VF	XX.XXXX	08.0000
TARGET T/D	XX.XXX	29.000
TOTAL T/D	XX.XXX	46.000
PCT T1	XXXXXXXX	12345670
PCT T2	XXXXXXXX	01234567
FIRST GRID	XX-XX	23-09
SECOND GRID	XX-XX	30-18
ELEVATION	SXXXXX	-00078
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	20.0

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

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```
X FID=+ 90090
Y FID=+ 0

SEND NEXT FID

X FID=+ 0
Y FID=+ 190000

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

VIEWER INITIALIZED

LAT= 23D 10M 58.8S N
LONG= 109D 38M 27.6S E

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73    1605+

POINTING COUNT= 5    FILM DRIFT= 0.00 MICRONS
```


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SK7A AND SC7A OPTIONS

OBTAINING
PARAMETERS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. All the parameters needed to use a stereoscopic option will be found in the parameter table. However, those parameters listed in the table that fall between "Fiducials" and "Elevation" for the SK7A option and "Emulsion" and "Elevation" for the SC7A option must be obtained for both frames or chips.

CHOOSING
ELLIPSOIDS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use.

DETERMINING PAYLOAD
CLOCK TIME

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. The procedures for determining payload clock time for a stereoscopic option are the same as those for a monoscopic option except that you must determine the payload clock time for both frames or chips.

MARKING FIDUCIALS OR
MEASURING GRID COORDINATES

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. The procedures for marking fiducials or measuring grid coordinates for a stereoscopic option are the same as those for a monoscopic option except that you must mark fiducials or measure grid coordinates for both frames or chips.

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INITIALIZING
A TELETYPE

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use.

SUBMITTING
PARAMETERS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. The procedures for submitting parameters for a stereoscopic option are the same as those for a monoscopic option with the following exception. When using a stereoscopic option, the program will request some of the parameters twice. The first request will be for all the parameters for the left frame or chip and the second will be for the right frame or chip.

INITIALIZING
A COMPARATOR

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you want to use. The procedures for initializing a comparator for a stereoscopic option are the same as those for a monoscopic option with the following exception. You must transmit fiducials or grid points for both frames or chips. Transmit the fiducials or grid points for the left frame or chip first.

RELATIVE
ORIENTATION

The relative orientation (R/O) of the frames or chips you are viewing with respect to each other should result in more accurate measurements. To calculate the relative orientation you must transmit from 6 to 20 corresponding points (R/O points) on each frame or chip simultaneously. These points must be as close as possible to the same ground elevation. Before transmitting the R/O points you must press the R/O output function button. The program is now ready to receive the R/O points.

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Transmitting
R/O Points

Move the crosshairs over the first R/O point to be transmitted. Send this point as an initial point. You will receive this message:

SEND NEXT POINT

Except for the last R/O point all R/O points must be sent as initial points. Each time you send an R/O point as an initial point, you will receive this message:

SEND NEXT POINT

Send the last R/O point as a terminal point. At this time an additional pitch, roll, and yaw will be calculated and printed on the teletype along with the following message:

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

RE-SET R/O SWITCH

Release the R/O button.

If you choose, you may have the coordinates of the R/O points printed on the teletype. To do this press the CMC ECHO button before you transmit the R/O points. Every time you send an R/O point as an initial point, you will receive this message:

SEND NEXT POINT

CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS
CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS

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When you transmit the terminal R/O point, you will receive this message:

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

RE-SET R/O SWITCH

CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS
CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS

Should you make an error while transmitting the R/O points, you can correct it by deleting the erroneous transmission. For example, if you send an incorrect R/O point as an initial point, you can delete that transmission by sending an intermediate point. You will receive this message:

LAST POINT DELETED

If you have transmitted several erroneous initial points, send the same number of intermediate points, and when the last intermediate point is received, you will receive this message:

ALL POINTS DELETED

After you have transmitted the R/O points and received the additional pitch, roll, and yaw, you are ready to transmit points for mensural calculations as described in the following section. However, if you find that the additional pitch, roll, and yaw do not result in more accurate calculations, you can nullify the relative orientation or recalculate it.

Nullifying The Relative Orientation

To nullify the relative orientation, release the R/O button and press the SET R/O TO IDENTITY button. Transmit a point for mensural calculations.

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You will receive the mensural output requested and this message:

R/O SET TO IDENTITY MATRIX

You are ready to continue transmitting points for mensural calculations without the additional pitch, roll, and yaw.

Recalculating The Relative Orientation

To recalculate the relative orientation, first nullify it, and then recalculate the relative orientation according to the procedures described on the previous pages.

TRANSMITTING POINTS FOR CALCULATIONS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you are using.

SWITCHING FROM A STEREO OPTION TO A MONO OPTION

When you are using a stereo comparator, you can switch to a monoscopic option for either the left or right stage and back to stereo without reinitializing the comparator by turning the second rotary switch in the first row of rotary switches to the setting which corresponds to the option you want. The second rotary switch settings and the options are:

Second Rotary Switch Setting	Option
Ø	Stereo
1	Mono - left stage
2	Mono - right stage

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You must also turn the first rotary switch which indicates the output functions you will use to the desired setting. There are different settings for stereoscopic and monoscopic options. (See CHAPTER II, USING THE OUTPUT FUNCTION BUTTONS section.)

When switching from one option to another, the first point transmitted after turning the first and second rotary switches to the desired settings must be an initial point. After sending an initial point, you will receive one of the following messages which indicates which option has been selected prior to any printed output:

BOTH FRAMES - STEREO
RIGHT FRAME
LEFT FRAME

If the first point transmitted is other than an initial point, you will receive the following message:

ILLEGAL POINT SEQUENCE

If you receive this message, transmit the next point as an initial point.

TERMINATING FRAME
OPERATIONS

Refer to this section under the monoscopic option that corresponds to the stereoscopic option you are using.

SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		SK7A
LOAD FILM		
PROJECT NUMBER	XXXXXX	920022
EMULSION	ZZ	DN
FIDUCIALS	X	2

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MISSION	XXXX	[redacted]
REV	XXX	090
ACC	XX	008
FOCAL LENGTH	XXX.XX	120.09
MIRROR PITCH	SXX.XXXX	-09.0066
MIRROR CRAB	SXX.XXX	-00.456
VEH PITCH	SXX.XXXX	+03.0600
VEH ROLL	SXX.XXX	+10.444
VEH YAW	SXX.XXXX	+01.1600
NADIR-LAT T1	XX-XX.XXZ	23-55.11S
NADIR-LAT T2	XX-XX.XXZ	23-50.23S
NADIR-LONG T1	XXX-XX.XXZ	123-09.44E
NADIR-LONG T2	XXX-XX.XXZ	123-12.23E
INER VEL T1	XXXXX.XX	25000.09
INER VEL T2	XXXXX.XX	24998.90
VEH AZIM T1	XXX.XXX	089.098
VEH AZIM T2	XXX.XXX	087.087
FLT PTH/T1	SX.XXXX	+1.0990
FLT PTH/T2	SX.XXXX	+1.1100
EL-SUN T1	XX.X	45.0
EL-SUN T2	XX.X	45.0
SUN-AZ T1	XXX.X	100.0
SUN-AZ T2	XXX.X	100.0
HEIGHT T1	XXX.XXX	090.090
HEIGHT T2	XXX.XXX	088.089
VF	XX.XXXX	03.0996
TARGET T/D	XX.XXX	21.090
TOTAL T/D	XX.XXX	50.000
PCT T1	XXXXXXXX	12345670
PCT T2	XXXXXXXX	01234567
SHRINK	X.XXXX	0.3343
SLIT LENGTH	X.XXXXX	0.44297
TRANSLATION	XXXXXX	221569
MISSION	XXXX	1234
REV	XXX	095
ACC	XXX	009
FOCAL LENGTH	XXX.XX	120.09
MIRROR PITCH	SXX.XXXX	-09.0069
MIRROR CRAB	SXX.XXX	-00.450
VEH PITCH	SXX.XXXX	+03.0687
VEH ROLL	SXX.XXX	+10.440
VEH YAW	SXX.XXXX	+01.1597
NADIR-LAT T1	XX-XX.XXZ	22-55.10S
NADIR-LAT T2	XX-XX.XXZ	22-50.22S
NADIR-LONG T1	XXX-XX.XXZ	122-10.42E
NADIR-LONG T2	XXX-XX.XXZ	122-11.22E
INER VEL T1	XXXXX.XX	23000.10
INER VEL T2	XXXXX.XX	24990.85

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VEH AZIM T1	XXX.XXX	090.090
VEH AZIM T2	XXX.XXX	089.089
FLT PTH/T1	SX.XXXX	+1.0999
FLT PTH/T2	SX.XXXX	+1.1199
EL-SUN T1	XX.X	44.0
EL-SUN T2	XX.X	44.0
SUN-AZ T1	XXX.X	101.0
SUN-AZ T2	XXX.X	101.0
HEIGHT T1	XXX.XXX	095.095
HEIGHT T2	XXX.XXX	090.089
VF	XX.XXXX	03.0999
TARGET T/D	XX.XXX	22.085
TOTAL T/D	XX.XXX	45.000
PCT T1	XXXXXXXX	25436754
PCT T2	XXXXXXXX	25437734
SHRINK	X.XXXX	0.3345
SLIT LENGTH	X.XXXXX	0.45385
TRANSLATION	XXXXXX	221575
ELEVATION	SXXXXX	+23578
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	25.9

INITIALIZE VIEWER--SEND LEFT FRAME FIDUCIALS

X FID=- 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 90000
Y FID=+ 0

BEGIN RIGHT FRAME

SEND NEXT FID

X FID=+ 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 244
Y FID=+ 87430

LEFT FRAME

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```
DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

RIGHT FRAME

DOF AZIM= 205.448 DEG
IN AZIM= 202.992 DEG

VIEWER INITIALIZED

BOTH FRAMES STEREO

SEND NEXT POINT

CMCX = 11122.2  MICRONS = 111211 COUNTS
CMCY = 11111.1  MICRONS = 111112 COUNTS
CMCX = 11133.2  MICRONS = 111333 COUNTS
CMCY = 11444.1  MICRONS = 114443 COUNTS

SEND NEXT POINT

CMCX = 22211.1  MICRONS = 222112 COUNTS
CMCY = 11110.0  MICRONS = 111111 COUNTS
CMCX = 33112.2  MICRONS = 332221 COUNTS
CMCY = 11122.3  MICRONS = 111224 COUNTS

SEND NEXT POINT

CMCX = 44422.1  MICRONS = 444222 COUNTS
CMCY = 44433.2  MICRONS = 444331 COUNTS
CMCX = 33322.1  MICRONS = 333211 COUNTS
CMCY = 33333.2  MICRONS = 333333 COUNTS

SEND NEXT POINT

CMCX = 55544.3  MICRONS = 555442 COUNTS
CMCY = 55443.2  MICRONS = 554431 COUNTS
CMCX = 55432.1  MICRONS = 554322 COUNTS
CMCY = 54433.3  MICRONS = 544332 COUNTS

SEND NEXT POINT

CMCX = 66665.4  MICRONS = 666653 COUNTS
CMCY = 66655.3  MICRONS = 666552 COUNTS
CMCX = 66644.4  MICRONS = 666443 COUNTS
CMCY = 66554.3  MICRONS = 665542 COUNTS
```


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RE-SET R/O SWITCH

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

CMCX = 77665.5 MICRONS = 776654 COUNTS
CMCY = 77655.4 MICRONS = 776553 COUNTS
CMCX = 77754.3 MICRONS = 777542 COUNTS
CMCY = 77644.2 MICRONS = 776441 COUNTS

LAT = 34D 39M 28.8S N
LONG = 86D 40M 25.6S W
HEIGHT = 1699.7326 FT

LEFT FRAME

LAT = 34D 39M 28.1S N
LONG = 86D 40M 21.0S W
GROUNDX = 89552.7 FT = 27295.7 METERS
GROUNDY = 68158.8 FT = -20774.8 METERS
GROUNDZ = 454704.9 FT = -141642.3 METERS

RIGHT FRAME

LAT = 34D 39M 30.4S N
LONG = 86D 40M 33.9S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1332+

POINTING COUNT= 18

DRIFT1= 0.00 MICRONS DRIFT2= 0.05 MICRONS

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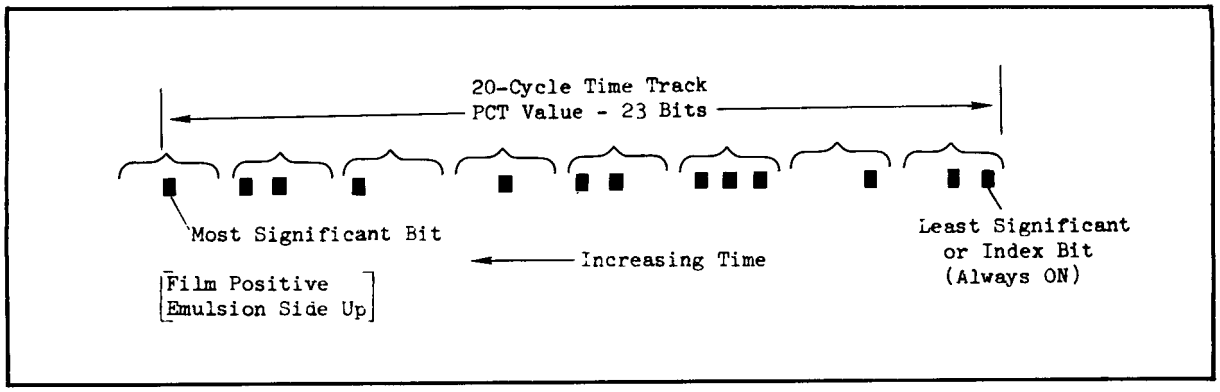

FIGURE 16. REFERENCE PCT WORD ON A KH-7 TIME TRACK.

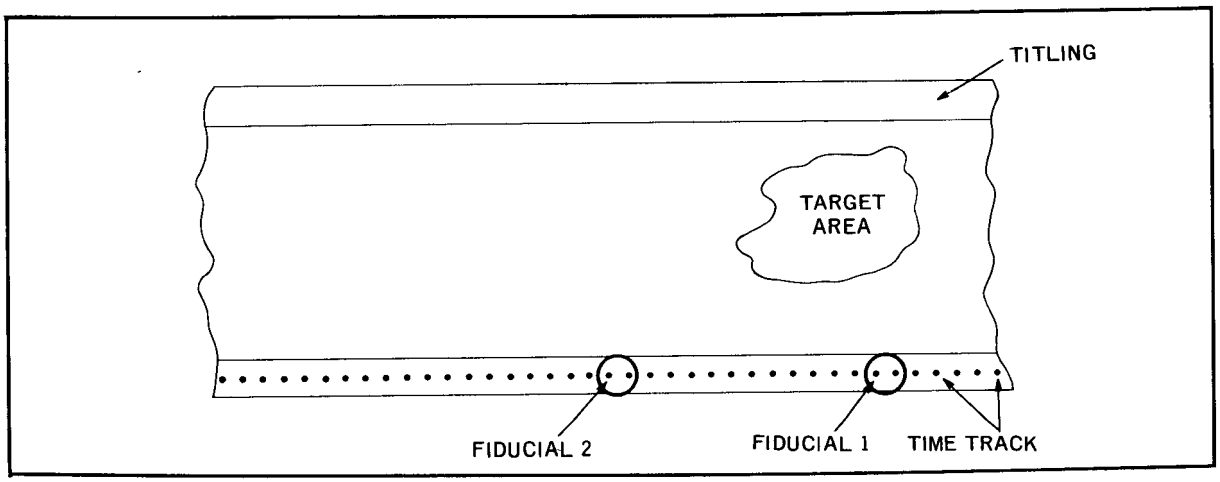

FIGURE 17. MARKING TWO FIDUCIALS ON KH-7 PHOTOGRAPHY, EMULSION SIDE UP.

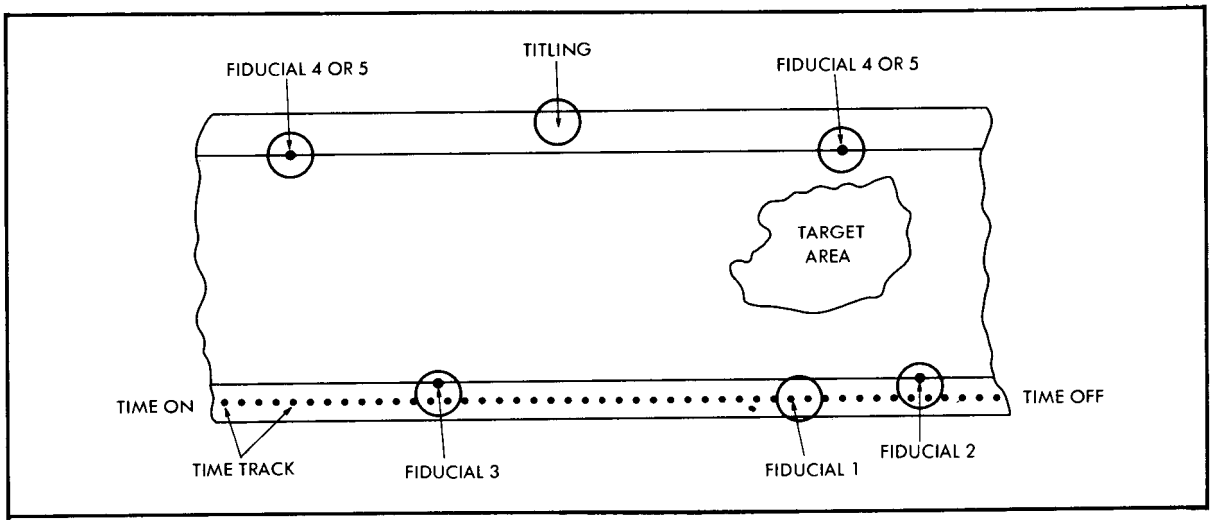

FIGURE 18. MARKING FIVE FIDUCIALS ON KH-7 PHOTOGRAPHY, EMULSION SIDE UP.

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CHAPTER VII. PROCESSING PANORAMIC PHOTOGRAPHY

Using the Real-Time Mensuration Program to process photography from any panoramic camera system involves these steps in the order listed.

STEP 1 obtaining parameters

STEP 2 choosing ellipsoids

STEP 3 marking fiducials

STEP 4 initializing a teletype

STEP 5 submitting parameters

STEP 6 initializing a comparator

STEP 7 transmitting points for calculations

STEP 8 terminating frame operations

There are two options under which panoramic photography may be processed. They are:

Monoscopic Option

PAN frame of photography derived from any panoramic camera system

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Stereoscopic Option

SPAN — two frames of photography derived from any panoramic camera system

When using the SPAN option, two additional steps are available. They are:

* transmitting relative orientation (R/O) points to calculate the relative orientation of the two frames of photography

* switching to the PAN option for either the left or right stage

Both of these steps are optional.

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PAN OPTION

OBTAINING
PARAMETERS

You will be responsible for obtaining all parameters needed for each use of the program. Parameters will identify the film you are processing, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional.

Before you use the program, assemble all required parameters. These parameters and some of their sources are listed in Table 27. Because of the wide range of photography that can be used with this option, all sources do not appear in the table. You must determine the best source where no source is provided.

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Table 27. Parameters Needed for PAN Option

Parameter	Source
System name; PAN	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must decide
Focal length; millimeters	----
Vehicle pitch; attitude relative to ground track; degrees & minutes	----
Vehicle roll; attitude relative to ground track; degrees & minutes	----
Vehicle yaw; attitude relative to ground track; degrees & minutes	----
Order (of rotation); Y=yaw, P=pitch, R=roll; enter correct letter combination	This manual
Nadir latitude; angular measurement; degrees, minutes & direction	----
Nadir longitude; angular measurement; degrees, minutes, & direction	----
Center of format latitude; degrees, minutes & direction	----
Center of format longitude; degrees, minutes & direction	----

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Table 27. Parameters Needed for PAN Option (Continued)

Inertial velocity; feet per second	----
Ground track velocity; feet per second	----
Inertial azimuth; degrees & minutes	----
Ground track azimuth; angular measurements; degrees & minutes	----
Sun elevation; degrees & minutes	----
Solar azimuth; degrees & minutes	----
Altitude (above mean sea level); feet	----
Scan rate; radians per second	----
IMC constant	----
IMC type; R for rotational, T for translational	This manual
First fiducial x; x coordinate of first grid intersection; millimeters	You measure & record
First fiducial y; y coordinate of first grid intersection; millimeters	You measure & record
Second fiducial x; x coordinate of second grid intersection; millimeters	You measure & record
Second fiducial y; y coordinate of second grid intersection; millimeters	You measure & record

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Table 27. Parameters Needed for PAN Option (Continued)

Third fiducial x; x coordinate of third grid intersection; millimeters	You measure & record
Third fiducial y; y coordinate of third grid intersection; millimeters	You measure & record
Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis--- Semi-minor axis--- E^2 ---	6378177.8 m. 6356796.05 m. .006693422
Krassovsky	KVY	Semi-major axis--- Semi-minor axis--- E^2 ---	6378245.0 m. 6356863.0188 m. .006693422
International	INT	Semi-major axis--- Semi-minor axis--- E^2 ---	6378388.0 m. 6356911.9961 m. .006722670
Clarke 1866	CRK	Semi-major axis--- Semi-minor axis--- E^2 ---	6378206.4 m. 6356583.8 m. .006768658
Bessel	BSL	Semi-major axis--- Semi-minor axis--- E^2 ---	6377397.155 m. 6356078.9628 m. .006674372
Army Map Service	AMS	Semi-major axis--- Semi-minor axis--- E^2 ---	6378270.0 m. 6356794.3434 m. .006722670

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MARKING
FIDUCIALS

One method of marking fiducials is presented here; other methods can be found which are equally good. Mount the film positive, emulsion side up, on a light table. Place a Universal Grid Number 2 over or under the film so that

* the X = 46 and Y = 12 grid intersection is aligned with the principal point of the film
* the grid lines are parallel to the format edges of the film
* the positive Y axis is in the direction of flight

With a pinpoint or by some other method, mark three points on the film at non-collinear grid intersections. Two to four inches between points is sufficient. These three points will be fiducials 1, 2, and 3, respectively.

Next,

* subtract 46 from each X value
* subtract 12 from each Y value
* multiply each grid coordinate by ten to convert it from centimeters to millimeters

The resultant values will be used as parameters. (See Table 27.)

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INITIALIZING
A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program the type of photography to be processed. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)
Type	INIT
Press	RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

Next,

Type	PAN
Press	RETURN key

You will then receive this message:

LOAD FILM

Load the film positive on the comparator. Procedures for mounting film on a comparator will depend on which comparator you use. These procedures can be found in CHAPTER II, THE EQUIPMENT.

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SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 920022

Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the

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correct character. The incorrect character will remain on the printed page. For example:

```
ENTER SYSTEM NAME    PAM↑N
```

You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

```
ENTER SYSTEM NAME              PAN
LOAD FILM
PROJECT NUMBER       XXXXXX    920032
EMULSION             ZZ        DELET     RETURN key
PROJECT NUMBER       XXXXXX    920022    RETURN key
EMULSION             ZZ
```

You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters.

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For example,

ENTER SYSTEM NAME		PAN	
LOAD FILM			
PROJECT NUMBER	XXXXXX	920032	
EMULSION	ZZ	DN	
FOCAL LENGTH	XXXX.XXX	DELET	RETURN key
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	920022	RETURN key
EMULSION	ZZ		

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

Correcting An Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simply type TERM and then press the RETURN key. The teletype will print TERM.

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INITIALIZING
A COMPARATOR

After you have submitted all parameters, this message will appear on the teletype:

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit fiducials to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the crosshairs over the point marked earlier as fiducial 1. Transmit fiducial 1 to the program by pressing the FIDUCIAL button. You will receive the comparator coordinates of fiducial 1 and this message:

SEND NEXT FID

Place the crosshairs over fiducial 2. Transmit fiducial 2 to the program by pressing the FIDUCIAL button. You will receive the comparator coordinates of fiducial 2 and this message:

SEND NEXT FID

Place the crosshairs over fiducial 3. Transmit fiducial 3 to the program by pressing the FIDUCIAL button. You will receive the comparator coordinates of fiducial 3 on the teletype. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

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TRANSMITTING POINTS
FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.
2. Release any output function buttons that may have been pressed.
3. Press the appropriate output function buttons for the calculations you want.
4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

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Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

TERMINATING FRAME
OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over fiducial 1. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

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Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

```
FRAME OPERATIONS TERMINATED    DATE    TIME
POINTING COUNT = XX    FILM DRIFT = XX.XX MICRONS
```

The pointing count is the total number of points transmitted including fiducials. Film drift is the distance the film has moved at fiducial 1 from the time the fiducials were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

SAMPLE TELETYPE OUTPUT

ENTER SYSTEM NAME		PAN
LOAD FILM		
PROJECT NUMBER	XXXXXX	920022
EMULSION	ZZ	DN
FOCAL LENGTH	XXXX.XXX	0600.000
VEH PITCH	SXX-XX	+09-09
VEH ROLL	SXX-XX	-08-00
VEH YAW	SXX-XX	+00-55
ORDER	ZZZ	YPR
NADIR-LAT	XX-XX.XXZ	09-09.09N
NADIR-LONG	XXX-XX.XXZ	009-09.09E
CTR FORMAT LAT	XX-XX.XXZ	11-11.11N
CTR FORMAT LONG	XXX-XX.XXZ	111-11.11W
IN VELOCITY	XXXXX	25000
GT VELOCITY	XXXXX	23000
IN AZIMUTH	XXX-XX	009-09
GT AZIMUTH	XXX-XX	008-08
EL-SUN	XX-XX	23-00
SUN-AZ	XXX-XX	224-98
ALTITUDE	XXXXXX	025000
SCAN RATE	SXX.XXX	+06.099
IMC CONSTANT	SXXXX.XXXX	+0123.0090
IMC TYPE	Z	T
1ST FID X	SXXX.XXX	+000.000
1ST FID Y	SXXX.XXX	+000.000
2ND FID X	SXXX.XXX	+111.111

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2ND FID Y	SXXX.XXX	+111.000
3RD FID X	SXXX.XXX	-090.000
3RD FID Y	SXXX.XXX	-088.000
ELEVATION	SXXXXX	+00900
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	20.0

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

X FID=+ 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 111111
Y FID=+ 111000

SEND NEXT FID

X FID=- 90000
Y FID=- 88000

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

VIEWER INITIALIZED

AZIMUTH= 92.33 DEG

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1559

POINTING COUNT= 6 FILM DRIFT= 0.00 MICRONS

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SPAN OPTION

OBTAINING
PARAMETERS

Refer to this section under PAN OPTION. All the parameters needed to use the SPAN option will be found in the parameter table. However, those parameters listed in the table that fall between "Emulsion" and "Elevation" must be obtained for both frames.

CHOOSING
ELLIPSOIDS

Refer to this section under PAN OPTION.

MARKING
FIDUCIALS

Refer to this section under PAN OPTION. The procedures for marking fiducials for the SPAN option are the same except that you must mark fiducials for both frames.

INITIALIZING
A TELETYPE

Refer to this section under PAN OPTION.

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SUBMITTING
PARAMETERS

Refer to this section under PAN OPTION. The procedures for submitting parameters for the SPAN option are the same with the following exception. When using this option, the program will request some of the parameters twice. The first request will be for all the parameters for the left frame and the second will be for the right frame.

INITIALIZING
A COMPARATOR

Refer to this section under PAN OPTION. The procedures for initializing a comparator for the SPAN option are the same with the following exception. You must transmit fiducials for both frames. Transmit the fiducials for the left frame first.

RELATIVE
ORIENTATION

The relative orientation (R/O) of the frames you are viewing with respect to each other should result in more accurate measurements. To calculate the relative orientation you must transmit from 6 to 20 corresponding points (R/O points) on each frame simultaneously. These points must be as close as possible to the same ground elevation. Before transmitting the R/O points you must press the R/O output function button. The program is now ready to receive the R/O points.

Transmitting
R/O points

Move the crosshairs over the first R/O point to be transmitted. Send this point as an initial point. You will receive this message:

SEND NEXT POINT

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Except for the last R/O point all R/O points must be sent as initial points. Each time you send an R/O point as an initial point, you will receive this message:

SEND NEXT POINT

Send the last R/O point as a terminal point. At this time an additional pitch, roll, and yaw will be calculated and printed on the teletype along with the following message:

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

RE-SET R/O SWITCH

Release the R/O button.

If you choose, you may have the coordinates of the R/O points printed on the teletype. To do this press the CMC ECHO button before you transmit the R/O points. Every time you send an R/O point as an initial point, you will receive this message:

SEND NEXT POINT

CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS
CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS

When you transmit the terminal R/O point, you will receive this message:

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

RE-SET R/O SWITCH

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```
CMCX = XXXXX.X      MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X      MICRONS = XXXXXX COUNTS
CMCX = XXXXX.X      MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X      MICRONS = XXXXXX COUNTS
```

Should you make an error while transmitting the R/O points, you can correct it by deleting the erroneous transmission. For example, if you send an incorrect R/O point as an initial point, you can delete that transmission by sending an intermediate point. You will receive this message:

LAST POINT DELETED

If you have transmitted several erroneous initial points, send the same number of intermediate points, and when the last intermediate point is received, you will receive this message:

ALL POINTS DELETED

After you have transmitted the R/O points and received the additional pitch, roll, and yaw, you are ready to transmit points for mensural calculations as described in the following section. However, if you find that the additional pitch, roll, and yaw do not result in more accurate calculations, you can nullify the relative orientation or recalculate it.

Nullifying The Relative Orientation

To nullify the relative orientation, release the R/O button and press the SET R/O TO IDENTITY button. Transmit a point for mensural calculations. You will receive the mensural output requested and this message:

R/O SET TO IDENTITY MATRIX

You are ready to continue transmitting points for mensural calculations without the additional pitch, roll, and yaw.

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Recalculating The
Relative Orientation

To recalculate the relative orientation, first nullify it, and then recalculate the relative orientation according to the procedures described on the previous pages.

TRANSMITTING POINTS
FOR CALCULATIONS

Refer to this section under PAN OPTION.

SWITCHING FROM A STEREO
OPTION TO A MONO OPTION

When you are using a stereo comparator, you can switch to a monoscopic option for either the left or right stage and back to stereo without reinitializing the comparator by turning the second rotary switch in the first row of rotary switches to the setting which corresponds to the option you want. The second rotary switch settings and the options are:

Second Rotary Switch Setting	Option
ø	Stereo
1	Mono - left stage
2	Mono - right stage

You must also turn the first rotary switch which indicates the output functions you will use to the desired setting. There are different settings for stereoscopic and monoscopic options. (See CHAPTER II, USING THE OUTPUT FUNCTION BUTTONS section.)

When switching from one option to another, the first point transmitted after turning the first and second rotary switches to the desired settings must be an initial point. After sending an initial point, you will receive

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one of the following messages which indicates which option has been selected prior to any printed output:

BOTH FRAMES - STEREO
RIGHT FRAME
LEFT FRAME

If the first point transmitted is other than an initial point, you will receive the following message:

ILLEGAL POINT SEQUENCE

If you receive this message, transmit the next point as an initial point.

TERMINATING FRAME
OPERATIONS

Refer to this section under PAN OPTION.

SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		SPAN
LOAD FILM		
PROJECT NUMBER	XXXXXX	920022
EMULSION	ZZ	DN
FOCAL LENGTH	XXXX.XXX	0600.000
VEH PITCH	SXX-XX	+09-09
VEH ROLL	SXX-XX	-08-08
VEH YAW	SXX-XX	+00-55
ORDER	ZZZ	YPR
NADIR-LAT	XX-XX.XXZ	09-09.09N
NADIR-LONG	XXX-XX.XXZ	009-09.09E
CTR FORMAT LAT	XX-XX.XXZ	11-11.11N
CTR FORMAT LONG	XXX-XX.XXZ	111-11.11W
IN VELOCITY	XXXXX	25000
GT VELOCITY	XXXXX	23000

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IN AZIMUTH	XXX-XX	009-09
GT AZIMUTH	XXX-XX	008-08
EL-SUN	XX-XX	23-00
SUN-AZ	XXX-XX	224-98
ALTITUDE	XXXXXX	025000
SCAN RATE	SXX.XXX	+06.099
IMC CONSTANT	SXXXX.XXXX	+0123.0090
IMC TYPE	Z	T
1ST FID X	SXXX.XXX	+000.000
1ST FID Y	SXXX.XXX	+000.000
2ND FID X	SXXX.XXX	+111.111
2ND FID Y	SXXX.XXX	+111.000
3RD FID X	SXXX.XXX	-090.000
3RD FID Y	SXXX.XXX	-088.000
FOCAL LENGTH	XXXX.XXX	0602.000
VEH PITCH	SXX-XX	+10-10
VEH ROLL	SXX-XX	-09-00
VEH YAW	SXX-XX	+00-56
ORDER	ZZZ	YPR
NADIR-LAT	XX-XX.XXZ	10-10.10N
NADIR-LONG	XXX-XX.XXZ	010-10.10E
CTR FORMAT LAT	XX-XX.XXZ	12-12.12N
CTR FORMAT LONG	XXX-XX.XXZ	112-11.11W
IN VELOCITY	XXXXX	24000
GT VELOCITY	XXXXX	25000
IN AZIMUTH	XXX-XX	010-10
GT AZIMUTH	XXX-XX	009-09
EL-SUN	XX-XX	24-00
SUN-AZ	XXX-XX	225-99
ALTITUDE	XXXXXX	026000
SCAN RATE	SXX.XXX	+07.099
IMC CONSTANT	SXXXX.XXXX	+0124.0089
IMC TYPE	Z	T
1ST FID X	SXXX.XXX	+111.111
1ST FID Y	SXXX.XXX	+111.111
2ND FID X	SXXX.XXX	+000.000
2ND FID Y	SXXX.XXX	+000.000
3RD FID X	SXXX.XXX	-089.000
3RD FID Y	SXXX.XXX	-090.000
ELEVATION	SXXXXX	+00900
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	20.0

INITIALIZE VIEWER--SEND LEFT FRAME FIDUCIALS

X FID=+ 0
Y FID=+ 0

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```
SEND NEXT FID

X FID=+ 111111
Y FID=+ 111000

SEND NEXT FID

X FID=- 90000
Y FID=- 88000

BEGIN RIGHT FRAME

SEND NEXT FID

X FID=+ 111111
Y FID=+ 111111

SEND NEXT FID

X FID=+ 0
Y FID=+ 0

SEND NEXT FID

X FID=- 89000
Y FID=- 90000

LEFT FRAME

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

RIGHT FRAME

DOF AZIM= 205.448 DEG
IN AZIM= 202.992 DEG

VIEWER INITIALIZED

BOTH FRAMES STEREO

SEND NEXT POINT

CMCX = 11122.2 MICRONS = 111211 COUNTS
CMCY = 11111.1 MICRONS = 111112 COUNTS
CMCX = 11133.2 MICRONS = 111333 COUNTS
CMCY = 11444.1 MICRONS = 114443 COUNTS
```


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SEND NEXT POINT

CMCX = 22211.1 MICRONS = 222112 COUNTS
CMCY = 11110.0 MICRONS = 111111 COUNTS
CMCX = 33112.2 MICRONS = 332221 COUNTS
CMCY = 11122.3 MICRONS = 111224 COUNTS

SEND NEXT POINT

CMCX = 44422.1 MICRONS = 444222 COUNTS
CMCY = 44433.2 MICRONS = 444331 COUNTS
CMCX = 33322.1 MICRONS = 333211 COUNTS
CMCY = 33333.2 MICRONS = 333333 COUNTS

SEND NEXT POINT

CMCX = 55544.3 MICRONS = 555442 COUNTS
CMCY = 55443.2 MICRONS = 554431 COUNTS
CMCX = 55432.1 MICRONS = 554322 COUNTS
CMCY = 54433.3 MICRONS = 544332 COUNTS

SEND NEXT POINT

CMCX = 66665.4 MICRONS = 666653 COUNTS
CMCY = 66655.3 MICRONS = 666552 COUNTS
CMCX = 66644.4 MICRONS = 666443 COUNTS
CMCY = 66554.3 MICRONS = 665542 COUNTS

RE-SET R/O SWITCH

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

CMCX = 77665.5 MICRONS = 776654 COUNTS
CMCY = 77655.4 MICRONS = 776553 COUNTS
CMCX = 77754.3 MICRONS = 777542 COUNTS
CMCY = 77644.2 MICRONS = 776441 COUNTS

LAT = 34D 39M 28.8S N
LONG = 86D 40M 25.6S W
HEIGHT = 1699.7326 FT

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LEFT FRAME

LAT = 34D 39M 28.1S N
LONG = 86D 40M 21.0S W
GROUNDX = 89552.7 FT = 27295.7 METERS
GROUNDY = 68158.8 FT = -20774.8 METERS
GROUNDZ = 454704.9 FT = -141642.3 METERS

RIGHT FRAME

LAT = 34D 39M 30.4S N
LONG = 86D 40M 33.9S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1332+

POINTING COUNT= 18

DRIFT1= 0.00 MICRONS DRIFT2= 0.05 MICRONS

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CHAPTER VIII. PROCESSING FRAME PHOTOGRAPHY

Using the Real-Time Mensuration Program to process photography from any frame camera system involves these steps in the order listed.

STEP 1 obtaining parameters

STEP 2 choosing ellipsoids

STEP 3 marking fiducials

STEP 4 initializing a teletype

STEP 5 submitting parameters

STEP 6 initializing a comparator

STEP 7 transmitting points for calculations

STEP 8 terminating frame operations

There are two options under which FRAME photography may be processed. They are:

Monoscopic Option

FRAME frame of photography derived from any frame camera system

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Stereoscopic Option

SFRAME two frames of photography derived from any frame camera system

When using the SFRAME option, two additional steps are available. They are:

* transmitting relative orientation (R/O) points to calculate the relative orientation of the two frames of photography

* switching to the FRAME option for either the left or right stage

Both of these steps are optional.

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FRAME OPTION

OBTAINING
PARAMETERS

You will be responsible for obtaining all parameters needed for each use of the program. Parameters will identify the film you are processing, and they will be transmitted via an on-line teletype. If you want the program to produce a plot, you will also need a parameter for plot distance. The use of this capability is optional.

Before you use the program, assemble all required parameters. These parameters and some of their sources are listed in Table 28. Because of the wide range of photography that can be used with this option, all sources do not appear in the table. You must determine the best source where no source is provided.

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Table 28. Parameters Needed for FRAME Option

Parameter	Source
System name; FRAME	This manual
Project number; assigned by NPIC; 6 digits & alpha suffix if applicable	Current MIS active project listing
Emulsion; up or dn	You must decide
Focal length; millimeters	-----
Vehicle pitch; attitude relative to ground track; degrees & minutes	-----
Vehicle roll; attitude relative to ground track; degrees & minutes	-----
Vehicle yaw; attitude relative to ground track; degrees & minutes	-----
Order (order of rotation from image space to object space); Y=yaw, P=pitch, R=roll; enter correct letter combination	This manual
Nadir latitude; angular measurement; degrees, minutes & direction	-----
Nadir longitude; angular measurement; degrees, minutes & direction	-----
Ground track azimuth; angular measurement; degrees & minutes	-----
Inertial azimuth; degrees & minutes	-----

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Table 28. Parameters Needed for FRAME Option (Continued)

Sun elevation; degrees & minutes	-----
Solar azimuth; degrees & minutes	-----
Altitude (above mean sea level); feet	-----
First fiducial x; x coordinate of first grid intersection; millimeters	You measure & record
First fiducial y; y coordinate of first grid intersection; millimeters	You measure & record
Second fiducial x; x coordinate of second grid intersection; millimeters	You measure & record
Second fiducial y; y coordinate of second grid intersection; millimeters	You measure & record
Third fiducial x; x coordinate of third grid intersection; millimeters	You measure & record
Third fiducial y; y coordinate of third grid intersection; millimeters	You measure & record
Elevation (of target area); positive if above sea level; feet	Maps & research material
Ellipsoid; earth ellipsoid which best fits the target area	To meet your specifications
Plot distance; optional; distance in inches on plotter; for plotter initialization, used with image limits to determine scale	To meet your specifications

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CHOOSING
ELLIPSOIDS

When evaluating film you will indicate the earth ellipsoid which best fits the target area. Choose the best fitting ellipsoid out of the six presently available and enter the mnemonic for that ellipsoid as a parameter. The six ellipsoids, their mnemonics, and their measurements including the eccentricity squared (E^2) of each ellipsoid are given below.

Ellipsoid	Mnemonic	Measurement	
Mission Correlation Data or Mission Performance Report	MCD	Semi-major axis--- Semi-minor axis--- E^2 ---	6378177.8 m. 6356796.05 m. .006693422
Krassovsky	KVY	Semi-major axis--- Semi-minor axis--- E^2 ---	6378245.0 m. 6356863.0188 m. .006693422
International	INT	Semi-major axis--- Semi-minor axis--- E^2 ---	6378388.0 m. 6356911.9961 m. .006722670
Clarke 1866	CRK	Semi-major axis--- Semi-minor axis--- E^2 ---	6378206.4 m. 6356583.8 m. .006768658
Bessel	BSL	Semi-major axis--- Semi-minor axis--- E^2 ---	6377397.155 m. 6356078.9628 m. .006674372
Army Map Service	AMS	Semi-major axis--- Semi-minor axis--- E^2 ---	6378270.0 m. 6356794.3434 m. .006722670

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MARKING
FIDUCIALS

One method of marking fiducials is presented here; other methods, which are equally good, can also be used. Mount the film positive, emulsion side up, on a light table. Place a Universal Grid Number 2 over or under the film so that

* the X = 46 and Y = 12 grid intersection is aligned with the principal point of the film
* the grid lines are parallel to the format edges of the film
* the positive Y axis is in the direction of flight

With a pinpoint or by some other method, mark three points on the film at non-collinear grid intersections. Two to four inches between points is sufficient. These three points will be fiducials 1, 2, and 3, respectively. Next,

* subtract 46 from each X value
* subtract 12 from each Y value
* multiply each grid coordinate by ten to convert it from centimeters to millimeters

The resultant values will be used as parameters. (See Table 28.)

INITIALIZING
A TELETYPE

Before you can measure using the Real-Time Mensuration Program, the teletype must be initialized, that is, you must indicate to the program

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the type of photography to be processed. To initialize a teletype follow these instructions in the order given.

Press & release	ALT MODE key
Press	CTRL + U keys (simultaneously)
Type	INIT
Press	RETURN key

You will then receive this message on the teletype:

ENTER SYSTEM NAME

Next,

Type	FRAME
Press	RETURN key

You will then receive this message:

LOAD FILM

Load the film positive on the comparator. Procedures for mounting film on a comparator will depend on which comparator you use. These procedures can be found in CHAPTER II, THE EQUIPMENT.

SUBMITTING
PARAMETERS

You will now receive a series of messages requesting parameters. Each message will consist of a request for a specific parameter and the format

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of that parameter. Characters used in the formats are these:

X = number
Z = letter
S = plus or minus sign
- = dash
. = decimal point

As you receive each message, type the requested parameter in the correct format and then press the RETURN key. You must press the RETURN key after you enter each parameter. For example, when you receive this message

PROJECT NUMBER XXXXXX

complete the message by typing the correct project number.

PROJECT NUMBER XXXXXX 920022

Then press the RETURN key.

The program provides you with three methods for correcting errors. If you make an error(s) while submitting parameters, follow the appropriate set of instructions.

Correcting Characters

If the last character you typed was erroneous, you can correct it by using the upper case symbol on the N key (↑). Press the SHIFT key and the N key simultaneously. Pressing these keys will produce an arrow and delete the preceding character from the transmission. Then type the correct character. The incorrect character will remain on the printed page. For example:

ENTER SYSTEM NAME FRAMR↑E

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You can delete up to five consecutive characters. If you have more than one character to correct, press the SHIFT key and the N key to delete each one. Then type the correct characters.

Correcting Lines

If you have made an error in the preceding line, you can delete that line. Simply type DELET and then press the RETURN key. The preceding line, i.e., the parameter and its format, will be reprinted. Type the correct parameter and then press the RETURN key. For example,

ENTER SYSTEM NAME		FRAME	
LOAD FILM			
PROJECT NUMBER	XXXXXX	920032	
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	920022	RETURN key
EMULSION	ZZ		

You may delete as many lines as you wish. If you have more than one line to delete, type DELET and then press the RETURN key for each line. Each time you do this, the program will back up the parameter list one line. After you have deleted the last erroneous line and that parameter and its format have been reprinted, resume typing parameters. For example,

ENTER SYSTEM NAME		FRAME	
LOAD FILM			
PROJECT NUMBER	XXXXXX	920032	
EMULSION	ZZ	DN	
FOCAL LENGTH	XXXX.XXX	DELET	RETURN key
EMULSION	ZZ	DELET	RETURN key
PROJECT NUMBER	XXXXXX	920022	RETURN key
EMULSION	ZZ		

Except for the first parameter, i.e., the system name, all parameters may be deleted using this method.

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Correcting An Entire Parameter List

If you find that you have made several errors, you can delete the entire parameter list and begin again. To do this, type INIT and then press the RETURN key. The teletype will reprint ENTER SYSTEM NAME. Simply type the parameters again.

Terminating Frame Operations

At any time while you are submitting parameters, you may terminate frame operations. If you decide not to continue processing for any reason, simply type TERM and then press the RETURN key. The teletype will print TERM.

INITIALIZING A COMPARATOR

After you have submitted all parameters, this message will appear on the teletype:

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

Check the coordinate count on the control panel. The maximum permissible count is 999999. If the count is 9ØØØØØ or over, reset the counter to ØØØØØØ.

Before you can use a comparator to obtain dimensional data, it must be initialized, i.e., you must transmit fiducials to the program to establish a coordinate system. Using the X and Y drive and the X and Y wheels, place the crosshairs over the point marked earlier as fiducial 1. Transmit fiducial 1 to the program by pressing the FIDUCIAL button. You will receive the comparator coordinates of fiducial 1 and this message:

SEND NEXT FID

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Place the crosshairs over fiducial 2. Transmit fiducial 2 to the program by pressing the FIDUCIAL button. You will receive the comparator coordinates of fiducial 2 and this message:

SEND NEXT FID

Place the crosshairs over fiducial 3. Transmit fiducial 3 to the program by pressing the FIDUCIAL button. You will receive the comparator coordinates of fiducial 3. The direction of flight azimuth and the inertial azimuth will also be printed on the teletype. If they do not agree within a few degrees, there is an error in one of the parameters which was input from the teletype. You should locate the error and determine whether to continue or to start the program again. You will also receive this message:

VIEWER INITIALIZED

TRANSMITTING POINTS
FOR CALCULATIONS

You are now ready to transmit points to be used for calculations by the Real-Time Mensuration Program. However, if you want the program to produce a plot, you must first initialize the plotter. (See CHAPTER II, INITIALIZING A PLOTTER section.) Then follow the instructions given below for transmitting points for calculations.

1. Turn the first rotary switch to the desired setting.

2. Release any output function buttons that may have been pressed.

3. Press the appropriate output function buttons for the calculations you want.

4. Position the comparator crosshairs over each point you want to transmit. Transmit each of these points to the program by pressing the appropriate transmission button.

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Mensural calculations will be printed on the teletype. If you have elected to have the program produce a plot, you will also receive that on the [redacted] plotter.

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TERMINATING FRAME
OPERATIONS

After all measurements have been calculated, operations for the frame being processed must be terminated by pressing the FIDUCIAL button. Place the comparator crosshairs over fiducial 1. Press the FIDUCIAL button to begin the termination of frame operations. You will then receive this message on the teletype:

FIRST TERMINAL FID RECEIVED

Measurements can continue to be calculated until you press the FIDUCIAL button twice in succession. When you press the FIDUCIAL button a second time, you will receive this message:

FRAME OPERATIONS TERMINATED DATE TIME
POINTING COUNT = XX FILM DRIFT = XX.XX MICRONS

The pointing count is the total number of points transmitted including fiducials. Film drift is the distance the film has moved at fiducial 1 from the time the fiducials were first transmitted until frame operations were terminated. Extensive film drift may result in inaccurate mensural calculations.

SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		FRAME
LOAD FILM		
PROJECT NUMBER	XXXXXX	920022
EMULSION	ZZ	DN
FOCAL LENGTH	XXXX.XXX	0600.090
VEH PITCH	SXX-XX	+00-56

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VEH ROLL	SXX-XX	-12-09
VEH YAW	SXX-XX	-09-00
ORDER	ZZZ	YRP
NADIR-LAT	XX-XX.XXZ	12-09.77S
NADIR-LONG	XXX-XX.XXZ	123-23.99W
GT AZIMUTH	XXX-XX	123-09
IN AZIMUTH	XXX-XX	010-10
EL-SUN	XX-XX	09-09
SUN-AZ	XXX-XX	111-11
ALTITUDE	XXXXXXX	0700000
1ST FID X	SXXX.XXX	+000.000
1ST FID Y	SXXX.XXX	+000.000
2ND FID X	SXXX.XXX	+090.000
2ND FID Y	SXXX.XXX	-090.000
3RD FID X	SXXX.XXX	+000.000
3RD FID Y	SXXX.XXX	-090.000
ELEVATION	SXXXXX	+01000
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	21.0

INITIALIZE VIEWER--SEND FIRST FIDUCIAL

X FID=+ 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 90090
Y FID=- 90000

SEND NEXT FID

X FID=+ 0
Y FID=- 90000

VIEWER INITIALIZED

LAT= 12D 29M 30.8S S
LONG= 123D 39M 32.4S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1559

POINTING COUNT= 5 FILM DRIFT= 6.00 MICRONS

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SFRAME OPTION

OBTAINING
PARAMETERS

Refer to this section under FRAME OPTION. All the parameters needed to use the SFRAME option will be found in the parameter table. However, those parameters listed in the table that fall between "Emulsion" and "Elevation" must be obtained for both frames.

CHOOSING
ELLIPSOIDS

Refer to this section under FRAME OPTION.

MARKING
FIDUCIALS

Refer to this section under FRAME OPTION. The procedures for marking fiducials for the SFRAME option are the same except that you must mark fiducials for both frames.

INITIALIZING
A TELETYPE

Refer to this section under FRAME OPTION.

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SUBMITTING
PARAMETERS

Refer to this section under FRAME OPTION. The procedures for submitting parameters for the SFRAME option are the same with the following exception. When using this option, the program will request some of the parameters twice. The first request will be for all the parameters for the left frame and the second will be for the right frame.

INITIALIZING
A COMPARATOR

Refer to this section under FRAME OPTION. The procedures for initializing a comparator for the SFRAME option are the same with the following exception. You must transmit fiducials for both frames. Transmit the fiducials for the left frame first.

RELATIVE
ORIENTATION

The relative orientation (R/O) of the frames you are viewing with respect to each other should result in more accurate measurements. To calculate the relative orientation you must transmit from 6 to 20 corresponding points (R/O points) on each frame simultaneously. These points must be as close as possible to the same ground elevation. Before transmitting the R/O points you must press the R/O output function button. The program is now ready to receive the R/O points.

Transmitting
R/O Points

Move the crosshairs over the first R/O point to be transmitted. Send this point as an initial point. You will receive this message:

SEND NEXT POINT

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Except for the last R/O point all R/O points must be sent as initial points. Each time you send an R/O point as an initial point, you will receive this message:

SEND NEXT POINT

Send the last R/O point as a terminal point. At this time an additional pitch, roll, and yaw will be calculated and printed on the teletype along with the following message:

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

RE-SET R/O SWITCH

Release the R/O button.

If you choose, you may have the coordinates of the R/O points printed on the teletype. To do this press the CMC ECHO button before you transmit the R/O points. Every time you send an R/O point as an initial point, you will receive this message:

SEND NEXT POINT

CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS
CMCX = XXXXX.X MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X MICRONS = XXXXXX COUNTS

When you transmit the terminal R/O point, you will receive this message:

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

RE-SET R/O SWITCH

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```
CMCX = XXXXX.X      MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X      MICRONS = XXXXXX COUNTS
CMCX = XXXXX.X      MICRONS = XXXXXX COUNTS
CMCY = XXXXX.X      MICRONS = XXXXXX COUNTS
```

Should you make an error while transmitting the R/O points, you can correct it by deleting the erroneous transmission. For example, if you send an incorrect R/O point as an initial point, you can delete that transmission by sending an intermediate point. You will receive this message:

LAST POINT DELETED

If you have transmitted several erroneous initial points, send the same number of intermediate points, and when the last intermediate point is received, you will receive this message:

ALL POINTS DELETED

After you have transmitted the R/O points and received the additional pitch, roll, and yaw, you are ready to transmit points for mensural calculations as described in the following section. However, if you find that the additional pitch, roll, and yaw do not result in more accurate calculations, you can nullify the relative orientation or recalculate it.

Nullifying The Relative Orientation

To nullify the relative orientation, release the R/O button and press the SET R/O TO IDENTITY button. Transmit a point for mensural calculations. You will receive the mensural output requested and this message:

R/O SET TO IDENTITY MATRIX

You are ready to continue transmitting points for mensural calculations without the additional pitch, roll, and yaw.

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Recalculating The
Relative Orientation

To recalculate the relative orientation, first nullify it, and then recalculate the relative orientation according to the procedures described on the previous pages.

TRANSMITTING POINTS
FOR CALCULATIONS

Refer to this section under FRAME OPTION.

SWITCHING FROM A STEREO
OPTION TO A MONO OPTION

When you are using a stereo comparator, you can switch to a monoscopic option for either the left or right stage and back to stereo without reinitializing the comparator by turning the second rotary switch in the first row of rotary switches to the setting which corresponds to the option you want. The second rotary switch settings and the options are:

Second Rotary Switch Setting	Option
ø	Stereo
1	Mono - left stage
2	Mono - right stage

You must also turn the first rotary switch which indicates the output functions you will use to the desired setting. There are different settings for stereoscopic and monoscopic options. (See CHAPTER II, USING THE OUTPUT FUNCTION BUTTONS section.)

When switching from one option to another, the first point transmitted after turning the first and second rotary switches to the desired settings must be an initial point. After sending an initial point, you will receive one of the following messages which indicates which option has been selected prior to any printed output:

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BOTH FRAMES - STEREO
RIGHT FRAME
LEFT FRAME

If the first point transmitted is other than an initial point, you will receive the following message:

ILLEGAL POINT SEQUENCE

If you receive this message, transmit the next point as an initial point.

TERMINATING FRAME
OPERATIONS

Refer to this section under FRAME OPTION.

SAMPLE TELETYPE
OUTPUT

ENTER SYSTEM NAME		SFRAME
LOAD FILM		
PROJECT NUMBER	XXXXXX	920022
EMULSION	ZZ	DN
FOCAL LENGTH	XXXX.XXX	0600.090
VEH PITCH	SXX-XX	+00-56
VEH ROLL	SXX-XX	-12-09
VEH YAW	SXX-XX	-09-00
ORDER	ZZZ	YRP
NADIR-LAT	XX-XX.XXZ	12-09.77S
NADIR-LONG	XXX-XX.XXZ	123-23.99W
GT AZIMUTH	XXX-XX	123-09
IN AZIMUTH	XXX-XX	010-10
EL-SUN	XX-XX	09-09
SUN-AZ	XXX-XX	111-11
ALTITUDE	XXXXXXX	0700000
1ST FID X	SXXX.XXX	+000.000
1ST FID Y	SXXX.XXX	+000.000

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2ND FID X	SXXX.XXX	+090.000
2ND FID Y	SXXX.XXX	-090.000
3RD FID X	SXXX.XXX	+000.000
3RD FID Y	SXXX.XXX	-090.000
FOCAL LENGTH	XXXX.XXX	0600.050
VEH PITCH	SXX-XX	+00-55
VEH ROLL	SXX-XX	-12-09
VEH YAW	SXX-XX	-09-00
ORDER	ZZZ	YRP
NADIR-LAT	XX-XX.XXZ	10-00.75S
NADIR-LONG	XXX-XX.XXZ	120-20.00W
GT AZIMUTH	XXX-XX	009-00
IN AZIMUTH	XXX-XX	010-10
EL-SUN	XX-XX	10-10
SUN-AZ	XXX-XX	110-10
ALTITUDE	XXXXXXX	0700000
1ST FID X	SXXX.XXX	+000.000
1ST FID Y	SXXX.XXX	+000.000
2ND FID X	SXXX.XXX	+090.000
2ND FID Y	SXXX.XXX	-090.000
3RD FID X	SXXX.XXX	+000.000
3RD FID Y	SXXX.XXX	-090.000
ELEVATION	SXXXXX	+01000
ELLIPSOID	ZZZ	MCD
PLOT DIST	XX.X	21.0

INITIALIZE VIEWER--SEND LEFT FRAME FIDUCIALS

X FID=+ 0
Y FID=+ 0

SEND NEXT FID

X FID=+ 90090
Y FID=- 90000

SEND NEXT FID

X FID=+ 0
Y FID=- 90000

BEGIN RIGHT FRAME

SEND NEXT FID

X FID=+ 0
Y FID=+ 0

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SEND NEXT FID

X FID=+ 90090
Y FID=- 90000

SEND NEXT FID

X FID=+ 0
Y FID=- 90000

LEFT FRAME

DOF AZIM= 205.448 DEG
IN AZIM= 202.992 DEG

RIGHT FRAME

DOF AZIM= 205.352 DEG
IN AZIM= 202.388 DEG

VIEWER INITIALIZED

BOTH FRAMES STEREO

SEND NEXT POINT

CMCX = 11122.2 MICRONS = 111211 COUNTS
CMCY = 11111.1 MICRONS = 111112 COUNTS
CMCX = 11133.2 MICRONS = 111333 COUNTS
CMCY = 11444.1 MICRONS = 114443 COUNTS

SEND NEXT POINT

CMCX = 22211.1 MICRONS = 222112 COUNTS
CMCY = 11110.0 MICRONS = 111111 COUNTS
CMCX = 33112.2 MICRONS = 332221 COUNTS
CMCY = 11122.3 MICRONS = 111224 COUNTS

SEND NEXT POINT

CMCX = 44422.1 MICRONS = 444222 COUNTS
CMCY = 44433.2 MICRONS = 444331 COUNTS
CMCX = 33322.1 MICRONS = 333211 COUNTS
CMCY = 33333.2 MICRONS = 333333 COUNTS

SEND NEXT POINT

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CMCX = 55544.3 MICRONS = 555442 COUNTS
CMCY = 55443.2 MICRONS = 554431 COUNTS
CMCX = 55432.1 MICRONS = 554322 COUNTS
CMCY = 54433.3 MICRONS = 544332 COUNTS

SEND NEXT POINT

CMCX = 66665.4 MICRONS = 666653 COUNTS
CMCY = 66655.3 MICRONS = 666552 COUNTS
CMCX = 66644.4 MICRONS = 666443 COUNTS
CMCX = 66554.3 MICRONS = 665542 COUNTS

RE-SET R/O SWITCH

PITCH = -0D 1M 20.9S
YAW = -0D 10M 22.9S
ROLL = +0D 5M 21.9S

CMCX = 77665.5 MICRONS = 776654 COUNTS
CMCY = 77655.4 MICRONS = 776553 COUNTS
CMCX = 77754.3 MICRONS = 777542 COUNTS
CMCY = 77644.2 MICRONS = 776441 COUNTS

LAT = 34D 39M 28.8S N
LONG = 86D 40M 25.6S W
HEIGHT = 1699.7326 FT

LEFT FRAME

LAT = 34D 39M 28.1S N
LONG = 86D 40M 21.0S W
GROUNDX = 89552.7 FT = 27295.7 METERS
GROUNDY = 68158.8 FT = -20774.8 METERS
GROUNDZ = 454704.9 FT = -141642.3 METERS

RIGHT FRAME

LAT = 34D 39M 30.4S N
LONG = 86D 40M 33.9S W

FIRST TERMINAL FID RECEIVED

FRAME OPERATIONS TERMINATED JAN. 10,73 1332+

POINTING COUNT= 18

DRIFT1= 0.00 MICRONS DRIFT2= 0.005 MICRONS

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CHAPTER IX. TRANSMITTING SAMPLE POINTS FOR CALCULATIONS

Given a sample frame and the facilities that appear on that frame (Figure 25), assume that the required calculations for the sample are these:

Building A	length of sides; area; plot
Building B	geodetic coordinates; distance of three points from Building B; plot
Runway	length; azimuth; plot
Building C	relief height; width; length; plot
Railroad	azimuth (as it goes off the top of the frame)
	north arrow for plot

In Figure 25, the points are numbered in the order in which they may be transmitted for this sample. In addition, they are given alphabetic designators which denote the type of point to be transmitted. The designators used are I for initial, N for intermediate, T for terminal, and M for multiple. Instructions for transmitting the points to be used for calculations are given in Table 29.

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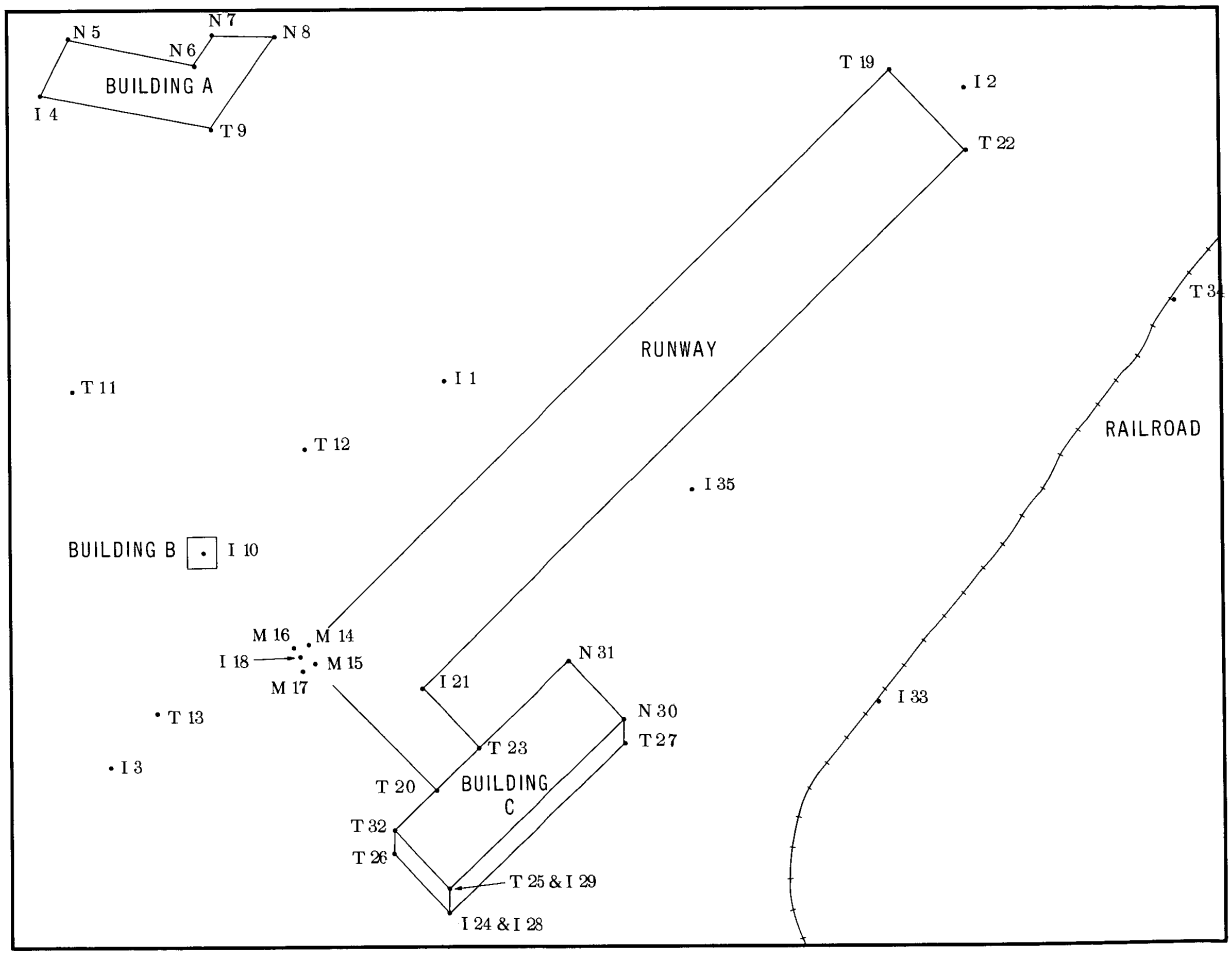

FIGURE 25. FACILITIES AND SAMPLE POINTS FOR CALCULATIONS. This figure is keyed to Table 29.

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Table 29. Instructions for Transmitting Sample Points for Calculations
(This table is keyed to Figure 25)

Required Calculation	Output Function Buttons	What To Transmit	Teletype Message
Bldg A plot	Press PLOTTER INITIALIZATION, CMC ECHO, POINT LABEL, & CHARACTER SEQUENCE	Transmit I1 as plotter origin	CMCX = 190000.00 MICRONS = 190000 COUNTS CMCY = 230326.00 MICRONS = 220326 COUNTS ORIGIN SET--SEND FIRST IMAGE LIMIT IDENT = TO 00001
		Transmit I2 as 1 outer limit of plot	CMCX = 360110.00 MICRONS = 360110 COUNTS CMCY = 311006.00 MICRONS = 311006 COUNTS SEND LAST IMAGE LIMIT IDENT = 00001 TO 00002
		Transmit I3 as other limit of plot	CMCX = 70091.00 MICRONS = 70091 COUNTS CMCY = 49936.00 MICRONS = 49936 COUNTS PLOTTER INITIALIZED SCALE 1:3624 IDENT = 00002 TO 00003
Bldg A length of sides area	Release PLOTTER INITIALIZATION; press AREA, LINE PLOT, & DISTANCE	Transmit corner of Bldg A as I4	CMCX = 38109.00 = 38109 COUNTS CMCY = 301037.00 MICRONS = 301037 COUNTS IDENT = 00003 TO 00004
		Transmit next corner as N5	DIST = 86.3 FT = 26.3 METERS CMCX = 50073.00 MICRONS = 50073 COUNTS CMCY = 321103.00 MICRONS = 321103 COUNTS IDENT = 00004 TO 00005
		Transmit next corner as N6	DIST = 105.1 FT = 32.0 METERS CMCX = 94935.00 MICRONS = 94935 COUNTS CMCY = 312022.00 MICRONS = 312022 COUNTS IDENT = 00005 TO 00006
		Transmit next corner as N7	DIST = 23.0 FT = 7.0 METERS CMCX = 100030.00 MICRONS = 100030 COUNTS CMCY = 320006.00 MICRONS = 320006 COUNTS IDENT = 00006 TO 00007
		Transmit next corner as N8	DIST = 39.9 FT = 12.2 METERS CMCX = 119688.00 MICRONS = 119688 COUNTS CMCY = 320205.00 MICRONS = 320205 COUNTS IDENT = 00007 TO 00008
		Transmit last corner as T9	DIST = 109.3 FT = 33.3 METERS AREA = 15805 SQ FT = 0.3628 ACRES CMCX = 99832.00 MICRONS = 99832 COUNTS CMCY = 290010.00 MICRONS = 290010 COUNTS IDENT = 00008 TO 00009
			DIST = 144.6 FT = 44.1 METERS IDENT = 00009 TO 00001
Bldg B Geo-coordinates	Release AREA, LINE PLOT, & DISTANCE; press GEODETIC COORDINATES & POINT PLOT	Transmit center point of Bldg B as I10	CMCX = 95305.00 MICRONS = 95305 COUNTS CMCY = 136009.00 MICRONS = 136009 COUNTS LAT = 27D 49M 49.4S N LONG = 82D 29M 9.0S W IDENT = TO 00010
Distance of 3 points from Bldg B plot	Release GEODETIC COORDINATE; press DISTANCE	Transmit T11	DIST = 302.5 FT = 92.0 METERS CMCX = 53621.00 MICRONS = 53621 COUNTS CMCY = 145145.00 MICRONS = 145145 COUNTS IDENT = 00010 TO 00011
		Transmit T12	DIST = 263.5 FT = 80.3 METERS CMCX = 130202.00 MICRONS = 130202 COUNTS CMCY = 200232.00 MICRONS = 200232 COUNTS IDENT = 00010 TO 00012
		Transmit T13	DIST = 102.4 FT = 31.2 METERS CMCX = 79892.00 MICRONS = 79892 COUNTS CMCY = 177097.00 MICRONS = 177097 COUNTS IDENT = 00010 TO 00013
Runway length plot	Release POINT PLOT; press LINE PLOT	Transmit M14, M15, M16, & M17 as multiple points for obscured corner Transmit same corner of runway as I18	CMCX = 130100.00 MICRONS = 130100 COUNTS CMCY = 130862.00 MICRONS = 130862 COUNTS IDENT = TO 00018
		Transmit opposite end of runway as T19	DIST = 4096.5 FT = 1248.6 METERS CMCX = 330123.00 MICRONS = 330123 COUNTS CMCY = 310066.00 MICRONS = 310066 COUNTS IDENT = 00018 TO 00019
		Transmit T20	DIST = 967.7 FT = 295.0 METERS CMCX = 175532.00 MICRONS = 175532 COUNTS CMCY = 65022.00 MICRONS = 65022 COUNTS IDENT = 00018 TO 00020

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Table 29. Instructions for Transmitting Sample Points for Calculations (Continued)

Required Calculation	Output Function Buttons	What To Transmit	Teletype Message
Runway azimuth	Press AZIMUTH	Transmit I21	CMCX = 171186.00 MICRONS = 171186 COUNTS CMCY = 100039.00 MICRONS = 100039 COUNTS IDENT = TO 00021
		Transmit T22	DIST = 3754.0 FT = 1144.2 METERS AZ = 136.521 DEG CMCX = 355518.00 MICRONS = 355518 COUNTS CMCY = 285857.00 MICRONS = 285857 COUNTS IDENT = 00021 TO 00022
		Transmit T23	DIST = 502.3 FT = 153.1 METERS AZ = 216.550 DEG CMCX = 190096.00 MICRONS = 190096 COUNTS CMCY = 78554.00 MICRONS = 78554 COUNTS IDENT = 00021 TO 00023
Bldg C relief height	Release DISTANCE, AZIMUTH, & LINE PLOT; press RELIEF HEIGHT	Transmit bottom corner of Bldg C as I24	CMCX = 180100.00 MICRONS = 180100 COUNTS CMCY = 22516.00 MICRONS = 22516 COUNTS IDENT = TO 00024
		Transmit corresponding top corner of Bldg C as T25	RELIEF HT = 62.3 FT CMCX = 180136.00 MICRONS = 180136 COUNTS CMCY = 25036.00 MICRONS = 25036 COUNTS IDENT = 00024 TO 00025
Bldg C width	Release RELIEF HEIGHT; press DISTANCE	Transmit T26	DIST = 432.5 FT = 131.8 METERS CMCX = 160779.00 MICRONS = 160779 COUNTS CMCY = 42538.00 MICRONS = 42538 COUNTS IDENT = 00024 TO 00026
Bldg C length		Transmit T27	DIST = 878.9 FT = 262.9 METERS CMCX = 240392.00 MICRONS = 240392 COUNTS CMCY = 81132.00 MICRONS = 81132 COUNTS IDENT = 00024 TO 00027
Bldg C plot	Release DISTANCE; press LINE PLOT	Transmit I28	CMCX = 180100.00 MICRONS = 180100 COUNTS CMCY = 22516.00 MICRONS = 22516 COUNTS IDENT = TO 00028
	Release LINE PLOT; press RELIEF PLOT	Transmit I29	CMCX = 180136.00 MICRONS = 180136 COUNTS CMCY = 25036.00 MICRONS = 25036 COUNTS RELIEF PLOT READY IDENT = TO 00029
		Transmit N30	CMCX = 240428.00 MICRONS = 240428 COUNTS CMCY = 83652.00 MICRONS = 83652 COUNTS IDENT = 00029 TO 00030
		Transmit N31	CMCX = 220311.00 MICRONS = 220311 COUNTS CMCY = 83762.00 MICRONS = 83762 COUNTS IDENT = 00030 TO 00031
		Transmit T32	CMCX = 160818.00 MICRONS = 160818 COUNTS CMCY = 46062.00 MICRONS = 46062 COUNTS IDENT = 00031 TO 00032 CHAR SEQ = N TO T IDENT = 00032 TO 00029
Railroad azimuth (as it goes off top of frame)	Release RELIEF PLOT; press AZIMUTH	Transmit I33	CMCX = 325325.00 MICRONS = 325325 COUNTS CMCY = 90900.00 MICRONS = 90900 COUNTS IDENT = TO 00033
		Transmit T34	AZ = 127.398 DEG CMCX = 425406.00 MICRONS = 425406 COUNTS CMCY = 220266.00 MICRONS = 220266 COUNTS IDENT = 00033 TO 00034
North arrow	Release AZIMUTH; press NORTH ARROW Move pen head on plotter to an area with no line or points	Transmit I35	CMCX = 425406.00 MICRONS = 425406 COUNTS CMCY = 220266.00 MICRONS = 220266 COUNTS IDENT = TO 00035

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CHAPTER X. ERROR MESSAGES

If an error of any type occurs, a message will by typed via the teletype. All of the error messages incorporated in the RTMP, their causes, and what to do if you receive one appear on the following pages. The messages are listed in alphabetical order.

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E R R O R M E S S A G E S

(F=fiducial, I=initial, M=multiple, N=intermediate, T=terminal)

Error Message	Cause	What To Do
ALL POINTS DELETED	In variable filmspeed option or when using CIRCLE, CYLINDER, or R/O functions, transmitted N points deleted all I points required for determining measurements	Transmit I points again as specified in appropriate option or function; do not reinitialize teletype
AZIMUTH PT DIST ERROR	Point that is less than 6 in. from previous point transmitted to get azimuth	Transmit point that is at least 6 in. from previous point
BUSY	Communication lines to program operating at full capacity	No new request can be handled at this time; wait & then try to initialize teletype again
CHARACTER OVERFLOW	More than 10 characters entered for one parameter	Enter parameter in correct format; format is printed via teletype
CHIP MATH ERROR	Conversion error on Chip comparator	Notify SSB/AID

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ERROR MESSAGES (Continued)

Error Message	Cause	What To Do
CMCECHO IS IN ERROR	Conversion error	Check points transmitted & then transmit sequence again; if error persists, notify SSB/AID; continue transmitting points for other output
COMPUTATION ERROR	Program unable to calculate results of points transmitted	Check points transmitted & then transmit sequence again; if error persists, notify SSB/AID
DRUM READ ERROR	Problem encountered in attempt to read data from mass storage area	Notify SSB/AID
DRUM WRITE ERROR	Problem encountered in attempt to place data on mass storage area	Notify SSB/AID
ENTER FIDUCIAL	Points to be used for calculations transmitted before comparator initialization	Initialize comparator by sending fiducials

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E R R O R M E S S A G E S (Continued)

Error Message	Cause	What To Do
ERROR IN DATA CONVERSION	Problem encountered in attempt to convert data to compatible form	Notify SSB/AID
ERROR - NOTIFY SSB/AID	Error	Notify SSB/AID
ERROR - RESEND PT SEQUENCE	Computer malfunction	Parameters & fiducials recovered; begin with I point of sequence & continue transmitting points
FILM DRIFT MATH ERROR	Conversion error	Notify SSB/AID; calculations are accurate because frame operations were terminated
FIRST THREE POINTS LINEAR	In CIRCLE function, calculations impossible with given points	Check points transmitted & transmit sequence again
FLOATING POINT ERROR	Error detected during calculations	Attempt to obtain calculations again; if error persists, notify SSB/AID

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E R R O R M E S S A G E S (Continued)

Error Message	Cause	What To Do
FORMAT ERROR	Parameter did not conform to format	Enter parameter in correct format; format is printed via teletype
HARDWARE ERROR	Hardware error	Notify SSB/AID
HARDWARE ERROR - DRUM	Hardware error	Notify SSB/AID
ILLEGAL FRAME	MPF options only; frame (or accession) number entered as parameter not part of specified pass (or revolution) for mission indicated	Reinitialize teletype; enter correct mission, pass, & frame numbers or mission, revolution, & accession numbers
ILLEGAL GRID	Three possible causes: 1) x coordinate of grid greater than 92 cm 2) y coordinate of grid greater than 24 cm 3) both 1 & 2	Reenter grid coordinates with x<92 & y<24 cm

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ERROR MESSAGES (Continued)

Error Message	Cause	What To Do
ILLEGAL PASS	MPF options only; pass (or revolution) number entered as parameter not part of mission indicated	Reinitialize teletype; enter correct mission, pass, & frame numbers or mission, revolution, & accession numbers
ILLEGAL PLT POINT	Point other than I transmitted for north arrow	Transmit I point for north arrow
ILLEGAL PLT POINT SEQUENCE	Point other than I transmitted for plotter initialization	If plot is desired, resend last point as I point If no plot is desired, release all plot output buttons
ILLEGAL POINT DESIGNATOR	Point designator other than F, I, N, T, or M received by program	Transmit last point again; if error persists, contact hardware maintenance personnel
ILLEGAL POINT SEQUENCE	Points transmitted out of sequence for desired output; e.g., a T point followed by an N when distance is desired output	Transmit points in correct sequence for desired output

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E R R O R M E S S A G E S (Continued)

Error Message	Cause	What To Do
ILLEGAL SYSTEM NAME	Erroneous entry for system name typed via teletype	Type correct system name (acronym for option, e.g., K4BR)
INITIALIZE PLOTTER	Plot output function buttons pressed before initialization of plotter	If plot is desired, initialize plotter as specified in CHAPTER II If no plot is desired, release all plot output function buttons
LINE PLOT ERROR	Point that is more than 29.5 inches from previous point transmitted for line plot	Transmit points within area specified during plotter initialization; previous point disregarded
LOCKOUT RELEASED	Hardware malfunction	Retype last parameter or retransmit last point, whichever is applicable
MAGNITUDE ERROR	Parameter not within logical bounds	Enter correct parameter
MATH MODEL ERROR	Conversion error in math model	Notify SSB/AID

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E R R O R M E S S A G E S (Continued)

Error Message	Cause	What To Do
MATRIX - NO INVERSE	In CIRCLE function, calculations impossible with given points	Check points transmitted & transmit sequence again
MISSION NOT AVAILABLE	Parameter for mission specified not in MPF	Process photography under option that does not retrieve parameters from MPF; e.g., if using K4BR, use K4B & enter all parameters specified in table
MULTIPLE PLOT ERROR	More than one output function button pressed	Release all plot output function buttons except one desired
NO CONVERGENCE 10 ITERATIONS	In CIRCLE function, no convergence possible	Check points transmitted & transmit sequence again
NO OUTPUT REQUESTED	No output function buttons pressed when points to be used for calculations were transmitted	Press appropriate output function buttons & then transmit points

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E R R O R M E S S A G E S (Continued)

Error Message	Cause	What To Do
NO PLOT AVAILABLE	Plot output function button pressed on comparator at remote station that has no plotter	Release plot output function button or go to remote station that has plotter
NORTH ARROW ERROR	Error detected in north arrow plotter routine	Attempt to plot north arrow again; if error persists, notify SSB/AID; plot is all right
PARITY ERROR	Viewer malfunction	Transmit point again; if error persists, notify OB/AID
PLOT RELIEF SEQUENCE ERROR	Other than I point sent as first point of sequence for which plot relief is desired output	Send correct I point; previous point disregarded
PLOTTER INITIALIZATION ERROR	Two possible causes: 1) attempt made to obtain plot when plot distance of Ø was entered as parameter	If no plot is desired, release plot output function buttons & continue measuring If plot is desired, reenter all parameters including correct parameter for plot distance; reinitialize plotter

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E R R O R M E S S A G E S (Continued)

Error Message	Cause	What To Do
PLOTTER INITIALIZATION ERROR (continued)	2) same point sent as two different target limits for plotter initialization	Reinitialize plotter by sending three I points: target center & two different target limits
POINT PLOT ERROR	Point that is more than 29.5 inches from previous point transmitted for point plot	Transmit points within area specified during plotter initialization; previous point disregarded
POINTING ERROR	Variable filmspeed options only; time marks required for determining measured filmspeed transmitted starting at fiducial 1 rather than fiducial 2	Time marks required for determining measured filmspeed must be transmitted starting at fiducial 2; transmit points correctly; previous points disregarded; do not reinitialize teletype
READY - INITIALIZE TELETYPE	Computer malfunction	Reinitialize teletype; parameters not recovered; reenter parameters

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E R R O R M E S S A G E S (Continued)

Error Message	Cause	What To Do
RETRIEVAL FILE DESTROYED	MPF file destroyed; in process of being re-created	Wait 10-minute intervals & keep trying to initialize teletype or process photography under option that does not retrieve from MPF (e.g., if using K4BR, use K4B & enter parameters in table)
RETRIEVAL MATH ERROR	Unsuccessful MPF retrieval	Notify SSB/AID
RETRIEVAL OUTPUT ERROR	Error detected in transmission of teletype message	Notify SSB/AID
TELETYPE IS LOCKED OUT	Information typed via teletype after comparator initialization	If calculations are desired, transmit points via comparator; no information should be typed at this time; if starting to process new frame, reinitialize teletype
TRANSFORMATION TO PLANE FAILED	In CIRCLE function, transformation impossible	Check points transmitted & transmit sequence again

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ERROR MESSAGES (Continued)

Error Message	Cause	What To Do
VIEWER INITIALIZATION ERROR	Same point transmitted for both fiducials 1 & 2 during comparator initialization	Transmit correct fiducials; message can also be received purposely; i.e., if after transmitting fiducial 1 you realize it was erroneous, transmit the erroneous point a second time; you will receive this error message; then transmit correct fiducials
VIEWER IS LOCKED OUT	Attempt made to transmit points to be used for calculations before comparator initialization	Reinitialize teletype & initialize comparator

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APPENDIX: S-AZIMUTH AND Z-AZIMUTH OUTPUT FUNCTIONS

The Real-Time Mensuration Program was modified to include two additional output functions after copy had already been prepared for the printer. Consequently, instructions for using the s-azimuth and the z-azimuth output functions are presented here rather than in CHAPTER II, Table 6, Output Function Buttons, and Table 7, Using Transmission and Output Function Buttons to Obtain Mensural Output.

There are no S-AZIMUTH and Z-AZIMUTH output function buttons as such. To use these functions, you must press the Q-AZIMUTH button.* When this button is pressed and an initial point transmitted to the Program, the q-azimuth, s-azimuth, and z-azimuth are printed on the teletype in the following format:

Q-AZIMUTH= XXX.XXX DEG
S-AZIMUTH= XXX.XXX DEG
Z-AZIMUTH= XXX.XXX DEG

S-AZIMUTH OUTPUT FUNCTION

The s-azimuth is the theoretical azimuth from the base of an object to the end of its shadow. The procedures for calculating the s-azimuth and the mensural output for each step are presented on the next page.

* The q-azimuth output function is discussed in Tables 6 and 7.

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Procedure	Mensural Output
Turn first rotary switch in top row of rotary switches to Ø or 2	--------
Press AZIMUTH, Q-AZIMUTH, & MI SHADOW HEIGHT output function buttons	--------
Transmit point at base of object as an initial point	Q-azimuth, s-azimuth, & z-azimuth
Release Q-AZIMUTH button	--------
Transmit point at end of object's shadow as terminal point	Azimuth & Ml shadow height

Compare the azimuth and the s-azimuth calculations. If they are not equal, then one or both of the points were transmitted inaccurately. You must determine if the accuracy you want will be satisfied with the discrepancy in azimuths. In general, you should attempt to achieve, the smallest difference possible between azimuths and check the Ml shadow height calculations with other height functions.

Z-AZIMUTH OUTPUT
FUNCTION

The z-azimuth is the theoretical azimuth from the base of an object to the projection of the top of the object into the local horizontal plane. The procedures for calculating the z-azimuth and the mensural output for each step are given on the next page.

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Procedure	Mensural Output
Turn first rotary switch in top row of rotary switches to Ø or 2	--------
Press AZIMUTH, Q-AZIMUTH, & RELIEF HEIGHT output function buttons	--------
Transmit point at base of object as initial point	Q-azimuth, s-azimuth, & z-azimuth
Release the Q-AZIMUTH button	--------
Transmit point at top of object as terminal point	Azimuth & relief height

Compare the azimuth and the z-azimuth calculations. If they are not equal then one or both of the points were transmitted inaccurately. You must determine if the accuracy you want will be satisfied with the discrepancy in azimuths. In general, you should attempt to achieve, the smallest difference possible between azimuths and check the relief height calculations with other height functions.

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